SCIENTIFIC AMERICAN SUPPLEMENT. No. 1155

Scientific American, established 1845.
Scientific American Supplement, Vol. XLV, No. 1155 } NEW YORK, FEBRUARY 19, 1898. { Scientific American Supplement, $5 a year.
Scientific American and Supplement, $7 a year.

OUR FUR SEALS.

THE first killing of the fur seal dates back to the time when Vitus Bering, in 1760, discovered the Aleutian Islands. A century ago the seal was probably the most numerous mammal on the face of the earth, but to-day like the bison of our Western plains it is fast becoming extinct. The Russian government, with feverish greed, began a wholesale slaughter of the seal, a war of extermination. At the time the United States purchased the Territory of Alaska with its appanages the Pribylov and the Aleutian Islands the profit from the fisheries had sunk into insignificance. The Pribylov Islands, with one or two other less known islands on the Kamtchatkan coast, are the only places in the waters of the North Pacific where the fur seal can breed, as the animals require a cold climate, a foggy atmosphere and a shelving beach, rocky and free from sand. The perpetual foggy weather is congenial and the animals dislike the sunshine. During the three months which they pass on the land they do not taste food but live by absorbing their own oil.

When the breeding time is over the seals scatter southward over the sea in search of food, and even while the breeding season lasts the female seals go sixty or eighty miles from land for the same purpose. This affords the opportunity to the "pelagic" sealer, who kills them in the open sea, outside territorial waters.

Russia early tried to keep this valuable fishery to herself, but international law does not concede sovereignty over waters other than inlets running deep into the land at a greater dis-

SEAL FISHERIES, PRIBYLOV ISLANDS—BACHELORS ON THE BEACH—ST. PAUL IN THE BACKGROUND.

FUR SEALS ON THE ST. PAUL ISLAND IN BERING SEA.

tance than three miles from the coast. In 1870 Congress prohibited the killing of seals in the waters of the mainland or the islands ceded by Russia, and in 1872 the Secretary of the Treasury protested that he was unable to control the sealers beyond the three miles. In 1875 the United States protested against Russia's claim to sovereignty over waters beyond this limit.

"There was reason to hope that the practice which formerly prevailed with powerful nations, of regarding seas and bays usually of large extent near their coasts as closed to any foreign commerce or fishery not specially licensed by them, was, without exception, a pretension of the past, and that no nation would claim exemption from the general rule of public law."

This protest must have been forgotten when, six years later, in 1881, the United States claimed sovereignty over that portion of the Bering Sea east of a line drawn from the Bering Straits to a point west of the westernmost of the Aleutian Isles, alleging that such sovereignty had passed by purchase from Russia to the United States. Nothing more was heard of this claim till 1886, by which time a considerable pelagic sealing business had grown up in the Bering Sea.

In that year pelagic sealing was going on extensively, conducted by Canadian schooners. Three of these vessels were seized by United States revenue cutters. The schooners were held for two years at Sitka, Alaska, and the masters and crews were fined and imprisoned. The British government protested, and the vessels were finally released. In 1887 and 1889 there were more seizures.

As the vessels were seized on the high seas, an indemnity was claimed, and a considerable sum of money has at last been paid. The only possible excuse for such proceedings was that Russia had transferred territorial rights in the Bering Sea to the United States government when Alaska was sold, but these rights had long before been held to be untenable. The differences between the United States and Great Britain occasioned endless trouble. The Hon. J. G. Blaine, the then Secretary of State, asserted five points: that prior to the cession of Alaska, Russia had insisted upon exclusive jurisdiction in the Bering Sea; that Great Britain had admitted these Russian rights; that the Bering Sea was not included in the comprehensive title of Pacific in the conventions by which Russia abandoned her claims; that the rights of Russia had passed unimpaired to the United States on the purchase of Alaska by the latter power; and that the seal herd, because its breeding grounds were on the United States territory, was always and everywhere the property of the United States.

The first British offer to the United States was this: to refer the question of seal extermination to a body of experts, and meantime to close to pelagic sealers a considerable area of water round the Pribylov Islands and outside territorial waters. For the American government was now professing to fear the imminent extirpation of the seal.

In 1891 both powers decided upon a recourse to arbitration. The British government passed the Bering Sea bill, which closed the fisheries of the Bering Sea to British subjects till the arbitrators' award was given; at the same time the United States stopped the killing of seals on the various islands. A joint commission visited the sealing grounds. And meantime the Canadian sealers, thus suddenly deprived of their livelihood, demanded compensation, for which the accommodating imperial government agreed to be liable.

In 1892 the arrangements for the arbitration were completed. All that year sealing was prohibited, and attempting sealers were seized by agreement between the two powers. The arbitrators were to render a verdict on each of Mr. Blaine's five points. If their decision was adverse to the United States, compensation was to be paid to British sealers for the loss of such catches as might have been made without undue injury to the seal herds. If their decision was in favor of the United States, Great Britain was to pay compensation for the loss due to abstention from killing seals on the islands. The arbitration treaty was ratified in May; and seven arbitrators were chosen, one each from Canada and Great Britain, two from the United States, one each from France, Italy, and Sweden. The prohibition of sealing was continued in force till the verdict had been pronounced, though there were bitter complaints in Canada at the long delays.

On August 15, 1893, the arbitrators made their award. On every one of the famous five points the verdict was against the United States. It was expressly affirmed that the Bering Sea was mare liberum, that the pelagic fishery was open to all, and that the United States had no proprietary right to the seals after these had left territorial waters. As for the damages which Great Britain claimed in consequence of this favorable verdict, the arbitrators found that the facts as stated by Great Britain were true, and that the United States must pay such sums as should be settled after assessment by the two powers. The measures finally decided upon for the protection of seal life were almost exactly those which the British had proposed in 1890. They were as follows:

1. No seals are to be killed by British or American subjects in the waters round Pribylov Islands, an imaginary line being drawn sixty miles from the coast.

2. A close season is established for seals during May, June and July, in the Eastern Pacific, north of 35° lat. and east of 180° long.

3. Only sailing vessels, aided by boats and canoes, may engage in the seal fishery within these limits.

4. A special license and a distinguishing flag must be carried by every vessel engaged in sealing.

5. Accurate entries of the date, place, number and sex of each seal captured shall be made in the logs of such vessels.

6. Firearms, nets and explosives may not be used to kill seals in the eastern half of Bering Sea, though shot guns can be used outside Bering Sea at other times than the close season and at all times in the western half.

Other less important provisions follow, allowing the coast Indians to kill seals in territorial waters. Finally these regulations were to be revised every five years, till abolished by consent of the two powers.

Most of the foregoing information is from an article by H. W. Wilson, in The Fortnightly Review, and the greater number of our illustrations from Ueber Land und Meer. In the SCIENTIFIC AMERICAN for January 22, 1898, there is an interesting article entitled "The Fur Seal," by Dr. Benjamin Sharp. This paper gives an excellent account of the habits of the fur seal.

From the bachelor rookeries at the Pribylov and Commander Islands are drawn the seals which give the skins to commerce. No others are taken. When the killing season arrives, herds are cut off from the sea at the rookery and are driven to the killing grounds. Any female which happens (but this is rare) to get into these herds is allowed to escape back to the shore. The herd is driven on, they arrive at the killing grounds near the village and are allowed to cool off, for skins would not retain their fur if the animal be killed when overheated. They are killed by a deft blow upon the head, then dexterously skinned; the skins are then salted, stored and are ready for shipment.

The Bering Sea pelagic catch of 1894 was 31,542, the seals being captured by twenty-seven Canadian and eleven American vessels. If the seals are found asleep, spearing is practicable, the distance being usually 30 to 35 feet. To the fur seal's unfortunate habit of sleeping much at sea is chiefly traceable its diminution, for it is at such times that it is most readily approached with gun and spear. It is largely the females which suffer, as the male seals do not leave the rookeries during the breeding season, and young pups cannot leave the immediate vicinity of the island until they depart on their first migration southward.

From the almost constant presence on the hauling grounds of the non-breeding males, it is also well established that they do not leave the islands to any great extent. The females alone constitute a class that feed at long distances from the islands during the breeding season. Their excursions in search of food extend over 200 miles, and commencing soon after the birth of their young are continued to the close of the season. There can be no doubt but that the nursing females are the most constantly exposed of any class of seals to the destructive methods of pelagic sealing in Bering Sea, and that their capture during the breeding season is, of all the agencies tending toward the diminution of the seal herd, the one most to be deplored.

The opening of Bering Sea to pelagic sealing has proved the most fatal of all the provisions of the Paris award. The effectiveness with which pelagic sealing may be carried on in a circumscribed hunting ground like Bering Sea may be more clearly set forth by directing attention to the number of hunting boats engaged during the past season. The sealing fleet consisted of 38 schooners, carrying from 6 to 20 boats or canoes apiece—the average number being about 12. The boats hunted in all directions, frequently going 10 miles away from the vessels to which they belonged, the hunting areas of the different schooners thus overlapping at times. Canoes have often been spoken 8 miles from their schooners. Pursuing seals in this systematic way, 38 vessels, carrying somewhat more than 450 boats, took 31,542 skins in six weeks, notwithstanding the fact that many of them were late in reaching Bering Sea from the Japan coast, and left early on account of having their North Pacific catches on board, for the purpose of being early in market, on account of the impatience of Indian hunters already wearied with the long Japan coast cruise, lack of provisions, or for other reasons. Of the Canadian fleet in Bering Sea, all but six schooners carried Indian hunters from Vancouver and Queen Charlotte Islands. These natives have been taking seals off their own shores with the spear from time immemorial, and it was a fatal mistake on the part of the Paris Tribunal to underestimate the efficiency of spears in such hands—a fact doubtless well known to those having charge of the British side of the case.

The spear used during the past season is very similar to that figured by Scammon twenty years ago in writing of pelagic sealing by these natives. The spear pole is 12 to 14 feet long, pronged, with two detachable barbed iron spear points, secured by a 30-yard line, the end of which is tied to the boat. When a seal is struck the barbed points slip off the pole, the latter being recovered after the seal has been pulled alongside the canoe and clubbed. Seals fight vigorously at such times and seldom fail to leave permanent marks of their sharp teeth on boats and canoes, while large bulls are very dangerous to handle.

Pelagic sealing is altogether impracticable for our own Aleut natives, their light skin-covered bidarkies not being constructed to withstand such attacks as wounded seals make with their teeth.

In 1894 the total catch of Canadian vessels, including the coast of British Columbia and Japan, was 94,474, the total tonnage of the sixty vessels was 3,866, manned by 1,401 men. The 51 American vessels killed 41,000 seals. The loss of young seals on the Pribylov Islands by starvation resulting from the killing of female seals in Bering Sea, in 1895, was 28,066.

MOTHERLESS SEAL PUP.

THE SENTINEL ON THE BEACH.

Grafting Wax of excellent quality is said to be obtained by the following recipe of the Soap Ind. and Fett Ind.: Melt 360 parts yellow soap, 180 parts pine resin, 180 parts tallow, and 120 parts turpentine. Pour into moulds and roll out.

THE PROGRESS OF ASTRONOMY IN 1897.

THE serious assault first made by the Rev. F. Howlett in 1886 on the "Wilsonian" hypothesis of the structure of sunspots, and repeated by him in presenting his splendid series of drawings of them to the Royal Astronomical Society, has been followed up by other observers of more or less eminence, and during the year that is just past, Messrs. Maunder, W. E. Wilson, Evershed, McDonall and Jenkinson, among others, have all helped, more or less, to give the coup de grâce to an "explanation" of these objects that has been copied and recopied from text book to text book during probably the entire lifetime of every one who will read these lines.

Among the metallic vapors which form the solar chromosphere and prominences, that of calcium occupies a conspicuous place. It is, however, represented by only one pair of bright lines, the H and K ones, situated close to the limit of visibility at the more refrangible end of the spectrum, while no less than seventy-five of the dark Fraunhofer lines are due to this element. It is a familiar fact that the wonderful day-by-day portraits of the prominences, faculæ, etc., taken by Prof. Hale at Chicago and by M. Deslandres in Paris, are obtained by the aid of this K line. Pledged to the non-elementary character of the elements, the professor at the physical observatory of the science and art department proclaimed that they were the emissions from some constituent of calcium, our terrestrial calcium being decomposed at the temperature of the sun, and experiments were undertaken in the laboratory there to prove his contention. But alas for his hypothesis! Like so many others which have emanated from the same source, this has been shown to be baseless by Sir William and Lady Huggins, who, in a paper read before the Royal Society on the seventeenth of last June, described a series of experiments showing conclusively and inexpugnably that calcium vapor in a sufficient state of attenuation, when an electrical discharge takes place through it, radiates the lines H and K alone; in short, its spectrum corresponds exactly with that of the prominences, which has thus been artificially produced, and yet another nail driven into the coffin of the hypothesis of the non-elementary nature of the elements.

It must be known to the majority of our readers that, at the instance of Dr. Gill, Her Majesty's astronomer at the Cape, a most elaborate series of observations of the minor planets Iris, Victoria and Sappho (in which something like 22 observatories took part, in various parts of the world) was commenced in the years 1888 and 1889, for the purpose of redetermining the solar parallax with the utmost attainable accuracy. The amount of work involved in such determination is simply inconceivable, and hence it will be no matter of surprise that the results have only been published during the year which is just past. We can merely say here that the final determination of this constant from the observations of which we have been speaking is 8·802″ ± 0·005″. Adopting Clarke's equatorial radius of the earth (20,926,202 feet), this places us at a mean distance of 92,874,000 miles from the mighty center of our system. It is worthy of notice that Prof. Harkness, by his exhaustive discussion of the solar parallax, as determined by every known method, deduced the value of 8·809″ for it; so that surely the superintendents of the English and American Nautical Almanacs, the Connaissance des Temps, and the Berliner Jahrbuch have ample justification for their decision to adopt 8·80″ as the parallax to be employed in and after 1901 in their respective national ephemerides. Of course, taking the parallax at 8·802″, the light equation becomes 498·46″ ± 0·28″, and if the accepted theory of aberration be true, and employing the Newcomb-Michelson velocity of light, we get as the constant of aberration 20·467″ ± 0·012″. Incidentally, the mass of the moon comes out—

$$\frac{1}{81{\cdot}702 \pm 0{\cdot}094} = 0{\cdot}012240 \pm 0{\cdot}000015.$$

The details of the geodetic survey of South Africa, too, in the shape of Dr. Gill's report, only arrived in England during the year 1897, albeit the survey itself was made during the period extending from 1883 to 1892, and was apparently executed with great precision. It is worthy of note that the resulting measures accord slightly better with Airy's figure of the earth than with Clarke's. Discordances, however, appear to have arisen from local attraction, the origin of which is obscure.

Dr. Chandler continues his investigations in connection with the (real or supposed) variation of latitude, and considers that recent observations tend to confirm his hypothesis that the axis of rotation of the earth moves within the earth itself, and that the north pole of the earth describes an ellipse (with axes 0·30″ and 0·08″) in 365 days, its major axis lying along a meridian 45° to the east of that of Greenwich. This question is, however, very far from settled.

The question of the rotation periods of Mercury and Venus is still sub judice. The latest determination of any value of that of the former planet has been given to the world through the medium of The Journal of the British Astronomical Association. It is by Herr Leo Brenner, who finds, from a series of most carefully made observations obtained during May, June, July and August, 1896, that the innermost member of the solar system has a day approximately 33·75 hours long. Quite recently that very able and exact observer, M. Antoniadi, of the observatory at Juvisy, has shown how and why the markings on Venus are spurious, and that a period of 224·7 days is only a trifle more worthless than one of 24 hours, as far as anything is really known of the planet.

The same acute astronomer has succeeded in visually duplicating certain geometrical figures, and so showing, inferentially, that the doubling of the Martian Canals has its origin in the eye of the observer.

Up to December 31, 1896, 425 of the minor planets were known. Since then Charlois has discovered four—two on August 25, one on August 27 and one on November 23; while on November 19 another was detected by Villiger. Ultimately, we suppose, Lemprière's dictionary will be exhausted in finding names for these pocket worlds.

No very notable discoveries have been made in connection with either of the planets Jupiter and Saturn during 1897. The former planet is in a perennial condition of change, and the drift on his surface has been established by the unwearied investigations of Mr. Stanley Williams. Divisions in the ring system of Saturn appear to be glimpsed at intervals by keen sighted observers. M. Antoniadi, of the Juvisy Observatory, has detected one, and Madame Manora, of Lussinpiccolo, another.

Herr Leo Brenner, of the Manora Observatory, has described a series of observations he made of the planet Uranus with a view to the discovery of its rotation period. As the most probable result, he concludes that the planet must rotate in about 8 h. 27 m. more or less. It is needless to add that we know no more of the physical condition of Neptune than we did when the year commenced.

The solitary comet actually discovered during the past year was found by Mr. Perrine, at the Lick Observatory, on October 16. It then exhibited a nucleus and a small tail, but even by the end of that month had become difficult to see. It was anticipated by many people that a striking exhibition of the Leonid Meteorites would be observable on the nights of the 13th and 14th of November. The display, however, was but a feeble and disappointing one.

Celestial photography shares in the general advance, and some recent photographs of nebulæ obtained by Mr. W. E. Wilson, F.R.A.S., of Daramona, Rathowen, surpass in brilliance and beauty of definition any that have been previously made. Messrs. Löwy and Puiseux continue the issue of their superb photographic atlas of the moon, from the Paris Observatory, and that of another one has commenced from Lick. It is on a scale of 38·36 inches to the diameter of our satellite, and will be in 60 sheets, with an index map. Dr. L. Weinek has issued a prospectus of a lunar atlas on a scale of about 10 feet to the moon's diameter, to appear in separate sheets 11½ inches by 9½ inches to that scale.

Up to the time of our writing we are ignorant whether a sufficient number of subscribers has been obtained to justify the eminent selenographer of Prague in issuing any part or parts of this. It must, ex necessitate, be a costly work to produce. Dr. Isaac Roberts, F.R.S., continues steadily and unobtrusively to produce those photographic pictures of nebulæ and clusters which have now become classical, and with which his name must be imperishably associated. A somewhat acrimonious discussion which has raged as to the relative advantages of silvered mirrors and portrait lenses for photographing the heavens seems to have resulted in the conclusion that each has its advantages and manifests its superiority for certain purposes. The work of forming the International Astrographic Chart and Catalogue has been systematically carried on in the observatories which have undertaken to share in it. The appearance of the first portion of the Cape Photographic Durchmusterung has formed an epoch making event in this connection. It only reached this country during the past year. So far, attempts to photograph superficial planetary detail have only been more or less failures.

The formal opening of the Yerkes Observatory on October 21 may well claim a leading place in a record of miscellaneous astronomical occurrences. The function, which extended over two days, was of a very imposing character, and worthy of an institution which possesses the very largest achromatic telescope in existence, and numbers among its staff men of such world wide eminence as Profs. Barnard, Burnham and Hale. To whom much is given, of him shall much be re-

KILLING SEALS.

quired, and men of science will look anxiously toward the shores of Lake Geneva for those discoveries which they confidently and legitimately expect from so brilliant a staff so thoroughly well equipped. Comparatively little has been heard in Europe during 1897 of or from the Lick Observatory. It is regrettable to find that Mr. Crossley's splendid gift of his 3 foot reflector has turned out a failure, and that, in the unanimous opinion of the observing staff on Mount Hamilton, it is very far indeed from being the perfect instrument they expected to find it. We learn that Prof. Holden, who has been the director since the foundation of the observatory in 1887, has resigned. There can, we imagine, be no possible doubt that that excellent astronomer and energetic observer Prof. Schaeberle will be his successor. At the Royal Observatory at Greenwich that monument of Sir Henry Thompson's munificence, the photographic equatorial, has been mounted. We need only mention that one end of the declination axis carries a photographic telescope of 26 inches in aperture and 22 feet 6 inches focal length, the 12¾ inches Merz, formerly the telescope of the great equatorial, and the 9-inch photo-heliograph; while at the other end of the axis is a 30-inch Cassegrainian reflector, with the 6-inch Hodgson telescope as a guiding one, to indicate the character of the famous surgeon's gift to the nation. Last, though very far from least, comes Mr. Frank MacClean's princely gift to the Royal Observatory at the Cape of Good Hope. Now that instrument and building are alike complete, we may look forward to an exhaustive spectroscopic survey of the entire southern heavens.

Among the new observatories erected during the year which has just ended may be mentioned three public ones, at Heidelberg, Odessa and Valkenburg respectively, and two private ones, one by M. V. Nielsen at Copenhagen and one by Dr. Seligmann at Middelfart. Ill health has, unfortunately, compelled Dr. Folie to retire from the directorship of the Royal Observatory at Brussels. Prof. Simon Newcomb, too, has retired from the superintendence of the American Nautical Almanac.

Prof. Turner, amid his multifarious occupations, has set on foot the construction of an ingenious photographic transit instrument for the Oxford University Observatory. Should this prove successful, it will be used to determine the places of the fundamental stars for the reduction of the Astrographic Catalogue. Remembering with what a flourish of trumpets and amount of personal detail certain expeditions left this country to observe the total solar eclipse of August 9, 1896, and what absolutely negative results they achieved, and recognizing to the full the wisdom of the utterance in I Kings xx 11, we abstain from giving details, etc., of those which have quitted England for India and Ceylon. We hope, however, to have more to say next year.

Popular interest in astronomy seems rather to increase than diminish, if we may judge from the steady progress of the British Astronomical Association, which, notwithstanding deaths and resignations, now numbers 1,180 members. That it acts as a feeder to that older and more important body, the Royal Astronomical Society, we have, we think, evidence in the fact of a steady growth in the number of candidates for the fellowship of the parent institution. The Liverpool Astronomical Society, the Leeds Astronomical Society, and the Astronomical Society of Wales have kept curiously in the background lately. Why, we are ignorant, as all have done, and are capable of doing, good work in their respective spheres.

No work of the first importance in astronomical literature has to be chronicled here, although several more or less useful and valuable ones have issued from the press during the year 1897. One, addressing particularly the practical astronomer, and expounding certain new and valuable methods, by Prof. Comstock, has appeared in vol. i of the Bulletin of the University of Wisconsin; and a handy and useful star atlas for students also has reached this country from the other side of the Atlantic. It is published by Messrs. Gunn & Company, of New York. Another New York firm of publishers—Silver, Burdett & Company—have issued a most useful and excellent addition to the student's library in the shape of "Elements of Descriptive Astronomy," by Dr. Herbert A. Howe. In this country, the first work issued which demands notice is Mr. Stebbing's "Navigation and Nautical Astronomy," an exceedingly well arranged book, crowded with examples fully worked out. Certainly, no more efficient an introduction to the subject could be desired. The "Concise Knowledge Astronomy," by Miss Agnes Clerke, Mr. Fowler and Mr. J. E. Gore, may also be mentioned, anything written by Miss Clerke and Mr. Gore being, as is tolerably well known, at once attractive and trustworthy. A second edition of Mr. Arthur Mee's capital "Observational Astronomy" is practically a new work, and cannot be easily surpassed as an introduction to the use of the telescope. The worker in the observatory will have welcomed Prof. Turner's modification and revision of the tables for facilitating the computation of star constants arranged by the late lamented Radcliffe observer, Mr. E. J. Stone. In their present form, the reduction of mean places of stars to their apparent ones is effected by them with the minimum of labor. A brochure on "La Planète Vénus," by Flammarion, just published by Gauthier-Villars, of Paris, is as exhaustive of the subject of our knowledge of that planet as might be expected by all familiar with the work of its eminent author.

Death has been fearfully busy among the ranks of astronomers during the year gone by, and many names have disappeared from the roll of those familiar to the scientific world. The first to be taken was he who was facile princeps among British selenographers, Mr. T. E. Gwyn-Elger. His work must be thoroughly familiar to everyone who has ever devoted the slightest attention to the physical structure of our satellite. He died of paralysis, at the comparatively early age of 59, on January 9. His loss is simply irreparable. He was followed on February 16 by the well known Russian astronomer, Dr. Wilhelm Döllen, who died in his 77th year. He began and ended his career at Dorpat, though for 46 years his name was a familiar one in connection with the Poulkova Observatory. His specialité was in astronomy as connected with geodesy. The death of M. d'Abbadie was also announced about the same time. He was alike distinguished as an astronomer and a geographer. He was 79 at the time of his death. Prof. von Haerdtl, of Innsbruck, who died in April at the age of 36, was chiefly known as an investigator of the movement of Winnecke's comet, of the terms of long period in the lunar theory and of an essay on Assyrian chronology. On May 9 there passed away a man whom English astronomy could but ill afford to lose, in the person of Edward James Stone, the Radcliffe observer at Oxford. While he was first assistant at Greenwich Observatory, Stone rediscussed the observations of the transit in 1769, a work rewarded by the gold medal of the Royal Astronomical Society in 1869. The main result of this discussion was to show that Encke had put an erroneous interpretation upon many of the observations he had employed in his calculation of the solar parallax. There can, however, be no doubt that the result deduced by Stone (8·91″) was in excess of the truth. The magnum opus of the lamented Radcliffe observer was, however, undoubtedly his Cape catalogue of 12,441 stars. It requires intimate practical knowledge of the nature of the task involved in such a production as this to appreciate the stupendous amount of labor it entails. His death was sudden. It followed an accidental fall into the water, but whether there was any connection between the two events seems uncertain. Although in no rigid sense an astronomer, Adam Hilger had contributed notably to the progress of the science by the beautiful—in fact, practically perfect—instruments, spectroscopic and other, with which he supplied the observer. He died, on April 23, from the effect of a bicycle accident at Brighton. Renowned as a computer, Mr. William Godward, formerly the chief assistant in the Nautical Almanac office, died in his 69th year on May 19. Several sets of tables devised and computed by him are in use there to the present day. The greatest maker of telescope lenses in the world, Prof. Alvan G. Clark, quitted the scene of his busy life on June 10. His name will go down to posterity as that of the man who made the mighty 36 inch objective of the Lick equatorial and the still mightier 40 inch one now installed in the Yerkes Observatory. Only two days later, on June 12, there passed away the Rev. Alexander Freeman, a name very familiar among those of amateur English astronomers. He was, however, more than an enthusiastic amateur, for from 1880 to 1882 he acted as deputy for the Plumian professor of astronomy at Cambridge. It was thought at one time that he would have succeeded Mr. Stone as observer at the Cape. He was 59 years of age. It is worthy of notice, as a coincidence, that on the same day, and at the same age, died Prof. Nobile, the second astronomer of the Royal Neapolitan Observatory. On August 5 died he who was universally regarded as the chief astronomical computer in this country. We refer, of course, to Albert Marth. He was, however, something more than this, for his knowledge of astronomical literature was encyclopedic. He was successively assistant to C. A. F. Peters, in Mr. Bishop's observatory in the Regent's Park, at the Durham Observatory, and to Mr. Lassell. Quitting the latter engagement in 1864, he held no permanent appointment until 1882, when he assumed the direction of Col. Cooper's observatory, at Markree Castle, in Ireland. Mr. Marth was universally known as the contributor to the Monthly Notices of the Royal Astronomical Society of those invaluable ephemerides of the satellites of the planets, and of the superficial detail of Mars and Jupiter, which were in use all over the world. His death creates a void which it will be hard indeed to fill. A week previously died Mr. Peal, of Assam, a name familiar to every reader of The English Mechanic as that of the author of a curious theory of lunar surfacing, of which he enjoyed the practical monopoly. He was in his 63d year. Finally, we have to announce the decease of another old contributor to these columns, Mr. Philip Vallance, who quitted the scene of his indefatigable labors on October 3, at the ripe old age of 95 years.—English Mechanic and World of Science.

TREES AND CHANGE OF TEMPERATURE.

IT looked as if we were gradually but surely passing to a lower general temperature in these latitudes. Observation does not, it is true, show that the mean temperature is lower than it was a century ago; but the disappearance of many plants which formerly flourished on this island and in Central Europe seems to indicate that such a change is in progress. A writer in La Semaine Horticole draws attention to certain changes which have occurred and are occurring in France at the present time, which favor the idea that the climate is becoming cooler. Many trees that formerly flourished in the North of France are no longer found there, and can only be met with in the extreme south, while several have entirely disappeared from the country. The lemon, once so general and prevalent in Languedoc, no longer grows there, and an orange tree cannot be found in Roussillon, where orange groves existed long ago. The Italian poplar, so common and so picturesque in ancient French etchings, is now rarely found on French soil, and only in the southern part of the republic. France was of old the fruit garden of Europe; but the changes of temperature have greatly limited the number and variety of fruits which can be grown in that country, and considerably restricted the area in which they flourished.

RENANTHERA IMSCHOOTIANA.

RENANTHERA COCCINEA, the oldest known species of the genus, is always admired when it flowers, but two things are generally urged against it, viz., its rambling habit of growth and the difficulty of flowering it. The Assamese species, R. imschootiana, however, is a plant of dwarf and neat habit, and so far as can be judged by the limited experience of it in gardens, a most floriferous one. It first flowered with Mr. A. Van Imschoot, of Mont St. Amand, Ghent, in 1891, and it was named in honor of that ardent lover of rare and curious orchids. On June 11, 1895, the specimen we here illustrate was exhibited by E. H. Woodall, Esq., of St. Nicholas House, Scarborough, at the Royal Horticultural Society, when the orchid committee voted it an award of merit. The prevailing color of the flowers is a brilliant scarlet crimson, with a slight trace of orange, the broad lower sepals being of that color.

RENANTHERA IMSCHOOTIANA—FLOWERS ORANGE-RED.

The narrow upper sepal and the petals are white, changing to yellow, the lower halves bearing some small and the outer halves larger crimson spots.—The Gardeners' Chronicle.

SUGGESTIONS CONCERNING THE MANUFACTURE OF COLD CREAM.

THERE is no pharmaceutical preparation concerning which more is written or for which more formulas have been given than cold cream. Nevertheless, if you purchase some from the average drug store, you will often not find it as white as it should be, and it will probably be lumpy and devoid of that creamy consistency which this preparation should possess. I have no new formula to offer, but I have a few suggestions to make as to manipulation, which will always insure perfect success if followed to the letter. This process has been used by me constantly in one of the largest pharmacies in the South, which does quite an extensive theatrical trade, and in which I have therefore had an opportunity to prepare large quantities of it a great many times.

I use the U. S. P. formula, but substitute distilled water for the rose water, and afterward add oil of rose. The formula for a convenient quantity of cream is as follows:

Spermaceti	40	ounces av.
White wax	38	"
Oil expressed almonds	12	pints.
Borax	1	ounce.
Distilled water	3¾	pints.

Pour the oil of almonds into a porcelain-lined vessel of sufficient capacity so that the cream may be stirred well. Add the spermaceti and wax to the oil, and heat over a slow fire until melted. Dissolve the borax in the water and pass through cotton into a Florence flask. Place the flask into the mixture contained in the vessel. Let the heat continue until the waxes are entirely melted, then pour the water from the flask into the vessel and heat for three minutes longer.

Have a larger vessel, partly filled with slightly warm

water, and place the first vessel in it. The larger kettle should be connected with a reservoir of ice water, which can be gradually added to the lukewarm water so as slowly to cool it off until the water is quite cold. Stir the mixture constantly from the time it is taken from the fire until it is quite cold. As the cream will cool rapidly in the cold water, the stirring can be conducted without much fatigue. When nearly cold, essences may be added to suit the taste and pocket-book of your patrons. Continue the stirring until quite cold.

The points to be observed are: (1) The wax used must be No. 1 white wax, not the extra white, as that usually contains paraffin, and this positively will not answer. (2) The best quality of spermaceti is also essential. (3) See that your oil of almonds is not rancid. Cold cream is intended to be an ointment, and a rancid oil might do harm. (4) The fire used in melting the waxes must not be too hot, for fear of setting up chemical decomposition.

It may be asked, What are the advantages of this process? Let us see. The reasons for the frequent failures in making cold cream are these: First, the difference of temperature of the two liquids when mixed, causing a separation of the two waxes, which are difficult to incorporate. This is avoided by heating them both at the same time to the same heat. Besides, a great many druggists have only one gas stove, and therefore do not find it convenient to heat the water before the wax. Second, the trouble of heating the second vessel (into which we are instructed by the Pharmacopœia to pour the cream) without smutting it causes a great many to dispense with this precaution. But if this be omitted, the sudden reduction of temperature on taking the melted waxes from the fire and putting them on the cold water bath may also cause separation of the waxes. This is avoided by using the same vessel for cooling the cream that we use for heating it. Third, the length of time usually required for cooling it in the open air is such that it is almost beyond human endurance to continue the stirring with sufficient rapidity to keep the ingredients thoroughly mixed; it is almost impossible to continue the operation for so long a time. This is avoided by the rapid cooling of the ice water. If you stir by hand, be sure that you use the lightest stirrer obtainable, so as not to become too wearied by the constant agitation.—William B. Parker, in Merck's Report.

CURE OF THE DEAF AND OF DEAF MUTES.*

SOME time ago we gave a description of an apparatus called the microphonograph, designed for awakening and educating the sense of hearing in the deaf. M. Dussaud, its inventor, in conjunction with Dr. Jaubert, formerly preparator at the Polytechnic School, and M. Berthon, well known for his work in telephony, has since been engaged in the labor of improving the apparatus, and has finally produced an instrument which in intensity (regulatable at will) and distinctness leaves all other systems of phonographs far in the rear. This improved apparatus, which we illustrate herewith, has recently been presented to the Academy of Medicine by Dr. Laborde, who made some sensational experiments upon deaf mutes in the presence of his colleagues there assembled.

Dr. Laborde has continued his researches in the Laboratory of Physiology, of which he is director, and has just published the result of his experiments in a note that will mark an epoch in the annals of science. We shall allow the eminent academician to speak for himself:

"We possess an improved microphonograph which give results of the highest interest, and which, as regards the sounds engendered, has the following advantages over the phonograph employed alone: (1) The sounds are greatly reinforced; (2) they are more distinct and are accompanied with hardly any twang; (3) their intensity can be regulated at will, so that the instrument constitutes a very sensitive audiometer; (4) they can be heard by a number of persons at once, owing to the multiple communications of the telephone; and (5), finally, they may be heard at great distances.

"We thus find ourselves in possession of a true automatic speaker easily manipulated for the auditory exercises necessary for the recuperation and practice of speech in such deaf mutes as have preserved a sufficient vestige of hearing, and the education of whom is to be undertaken and realized upon new bases. Up to the present, for want of appropriate means, the intervention of the organ of hearing thus abandoned to its native imperfection of operation has been and has had to be systematically neglected.

"In a word, it is an apprenticeship in speaking, through the auditory mechanism that naturally presides therein, rendered possible by the new apparatus, and that, too, under conditions which are singularly favorable; for, with a single apparatus, and owing to the multiple communications of the telephone, one professor may proceed with the education of a large number of subjects simultaneously.

"Not only does the microphonograph, by its mixed and appropriate operation, solicit and command the functional awakening of the auditory organ previously dormant, but through oft repeated exercises finally creates a memory for sounds, so that by the recalling and restoration of the function we restore the organ, and thus realize in practice the physiological principle that the function makes the organ.

"This functional and organic restoration is such that in the perceptive centers there is created, through the penetration of reinforced sounds and the repetition thereof, a true state of mental obsession of a nature to singularly aid the recuperation and the progressive return of the function.

"When, as a consequence of sufficient exercise, the auditory image of a vowel has been fixed in the brain, it will suffice to pronounce it in a loud voice in order that it may be heard. Finally, as a necessary consequence, the deaf person will pronounce more accurately any vowel of which he possesses the auditory image."

Although it cannot restore hearing to all deaf persons nor all deaf mutes, the microphonograph is, nevertheless, a most valuable instrument, and the name of its inventor and of his fellow laborers will figure some day alongside of those of the noble men who have done the most to improve the sad condition of the unfortunates whom a fatal stroke has deprived of hearing, if not of speech.

For the engravings and the above details we are indebted to La Nature.

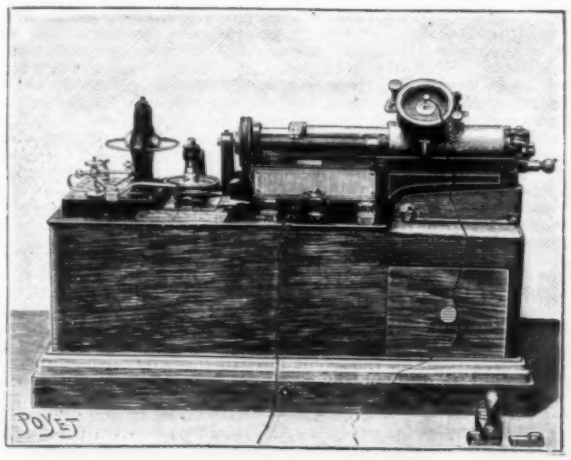


FIG. 1.—MICROPHONOGRAPH—ORDINARY MODEL.

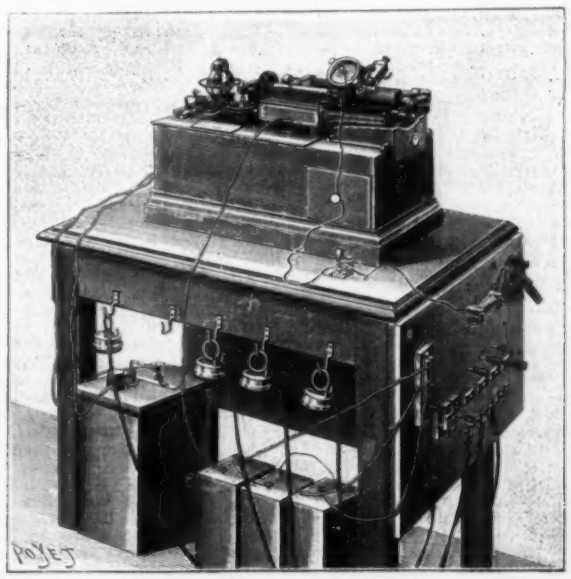


FIG. 2.—MICROPHONOGRAPH—MODEL FOR THE EDUCATION OF DEAF MUTES.

FIG. 3.—EXPERIMENT MADE BY M. JAUBERT UPON A DEAF MUTE BY MEANS OF THE DUSSAUD MICROPHONOGRAPH.

* See SCIENTIFIC AMERICAN SUPPLEMENT, No. 1117, p. 17851.

THE Orange Free State became a member of the International Postal Union on January 1, 1898.—Uhland's Wochenschrift.

A CASE OF JEALOUSY.

By WILLIAM O'NEILL, M.D., in Lancet.

AMONG the multitudinous and multifarious cases of disease reported year after year in the columns of The Lancet I have not seen a case of that very old and commonplace complaint jealousy—or "spirit of jealousy," as it is named in the Scriptures, where it is fully described and treated. I would therefore ask permission to mention a case of it that has come under my observation.

Some years ago I was requested to visit a lady who it was represented to me was very ill and who consequently required immediate attention. On entering the house I was shown into the so-called sick room, in which there were three persons, all of whom seemed to me to be in good health. There were present an old lady (the owner of the house) and her daughter, who had arrived a few days previously from a neighboring county to spend two or three weeks with her mother, and the daughter's husband, whose visit was only to be for a day or two. The man was about thirty-five years of age, small in stature, swarthy in complexion and plain looking. The wife was a striking contrast to her husband; she was rather tall, remarkably fair and handsome and was a few years younger than her good man. After taking a seat I asked which of them was the patient, but no answer having been given to my inquiry, I asked again. Then the younger lady with some hesitation said: "I am the patient and my complaint is jealousy. I am jealous of my husband, and if you do not give me something to relieve me, I shall go out of my mind." This accusation against the little man seemed to me to be most ridiculous. Indeed, I could not help thinking that if the accuser had been the accused it would have been more in the nature of things. I assured the lady I was extremely sorry for her, the more so that I was quite incompetent to treat such a case. However, I advised that a wise mutual friend should be consulted who would make things pleasant between husband and wife, for that in all probability there were no grounds for her suspicions. The husband protested his innocence and declared there was no cause whatever for her accusations. The wife persisted in reiterating them, and so the wran-

gle went on till suddenly she fell from her chair on the floor in a fit the spasmodic movements of which were so strange and varied that it would be almost impossible to describe them. At one moment the patient was extended at full length with her body arched forward in a state of opisthotonos. The next minute she was in a sitting position with the legs drawn up, making, while her hands clutched her throat, a guttural noise. Then she would throw herself on her back and thrust her arms and legs about to the no small danger of those around her. Then, becoming comparatively quiet and supine, she would quiver all over, while her eyelids trembled with great rapidity. This state perhaps would be followed by general convulsive movements in which she would put herself into the most grotesque postures and make the most unlovely grimaces. At last the fit ended, and exhausted and in tears she was put to bed. The patient was a lithe, muscular woman, and to restrain her movements during the attack with the assistance at hand was a matter of impossibility. So that all that could be done was to prevent her injuring herself and to sprinkle her freely with cold water. The after treatment was more geographical than medical. The husband ceased doing business in a certain town where the object of his wife's suspicions lived. He was enabled to do so by the kindness of a friend who exchanged part of his district with him.

This was not a case of epilepsy, for the muscular spasms of the patient were not exactly similar to those of that disease. Besides, there was no foaming at the mouth or biting of the tongue and consciousness was not, I think, at any time fully at abeyance, as is the case in epilepsy. The attack was a well developed hysterical fit, with a good deal of cataleptic rigidity of the muscles. The fit was not the disease, but it was the symptom or manifestation of a mind diseased or deranged, the state of the mind being the result of the woman's broodings over her real or imaginary wrongs. When the mind of a sensitive person is fixed on an all-absorbing subject like that of jealousy it may become unhinged, and when this is the case the brain may I think occasionally relieve itself by explosions of more or less uncontrollable and misdirected muscular energy. It lets off steam and perhaps prevents the boiler from bursting. But jealousy frequently assumes a violent and destructive character, for, as the wisest of the sons of men says: "Jealousy is as cruel as the grave; the coals thereof are coals of fire which have a most vehement flame." Not long after the above case came under my notice I read in the Standard newspaper an account of three murders each of which was attributed to jealousy.

Again, jealousy in an unobtrusive form may be found influencing the course of many diseases and sometimes it may take such a deep hold on the mind of a patient that it may be considered the disease itself. It is not often, however, that a female patient will reveal to a third person the cause of her mental depression, loss of sleep and appetite, and her unwillingness to leave her room and resume outdoor exercise. A husband may throw some light on a case that is making little or no progress toward recovery. I have had cases illustrative of this kind of jealousy and have had one lately, and thus I know that in treating them a man requires to be a diplomatist as well as a physician.

ON THE ABSORPTION OF HYDROGEN BY PALLADIUM AT HIGH TEMPERATURES AND PRESSURES.

By Prof. JAMES DEWAR, M.A., LL.D., F.R.S.

ONE of the author's earliest papers was entitled "The Motion of a Palladium Plate During the Formation of Graham's Hydrogenium." The explanation of the motion, together with a record of other experiments, can be found in the Proc. Roy. Soc. Edin., 1868, 6, 504.

A subsequent investigation by the author into the physical constants of hydrogenium appeared in the Trans. Roy. Soc. Edin., 1876, 27, 167, and had reference to the specific gravity, specific heat and coefficient of expansion of the occluded hydrogen. These observations led to the conclusion that the specific gravity was independent of the amount of condensed gas and had a mean value of 0·62. The specific heat, relatively to palladium, of the condensed hydrogen appeared to vary inversely as the quantity occluded, but taken relatively to successive charges was nearly constant, having the value 3·4, which is identical with that of gaseous hydrogen at constant pressure. The coefficient of cubical expansion of the alloy is about twice that of palladium, and that of the hydrogen in its compressed state not more than three times that of mercury. A later communication was made to the Philosophical Society of Cambridge (Proc., 1878, 3, 207) dealing with the thermo-electric relations and electric conductivity of hydrogenium. It was shown that the potential difference of a junction of hydrogenium-palladium is at ordinary temperature nearly equal to that of an iron-copper junction, and that it increases with the temperature according to the general parabolic law; the rate of the increase being, however, greater than iron-copper and subject to a regular variation on account of successive heatings. The formation of thermo-electric piles and of neutral points in a wire of this substance, along with the continuous formation of thermo-electric currents through the application of a hydrogen flame, were explained. Experiments on electric resistance proved that it increases directly with the amount of hydrogen condensed in the palladium.

Subsequent investigators have dealt more elaborately with the many problems suggested by hydrogenized palladium, but so far the essential facts referred to above have been confirmed.

In the course of the early observations the following experiment is recorded as illustrating the absorption of hydrogen by palladium at a red heat.

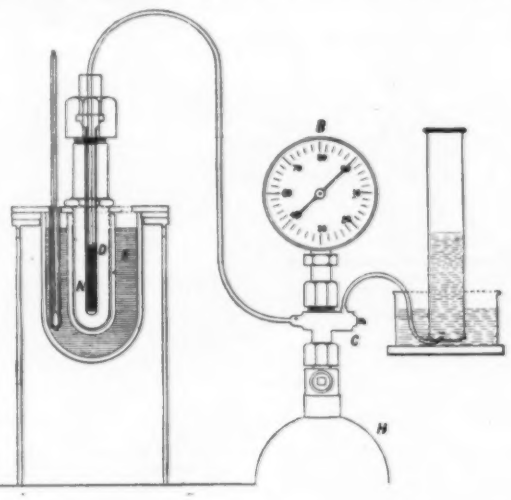
Take a strip of thin sheet palladium 4 or 5 cm. long and about 5 mm. in breadth; clamp it firmly by the end in a suitable support so that the strip is free to vibrate, and insert it edgeways in the middle of a hydrogen flame, burning from a nozzle about 1 mm. in diameter. If the palladium be now depressed into the inner dark cone, it immediately begins to vibrate, producing a low, musical note.

If the flame be extinguished by stopping the current of hydrogen for an instant, on allowing the gas to flow the vibration commences again and may be kept up without any actual flame.

The motion in this position in the flame is due to the absorption of hydrogen on the cool side next the inner cone, with its attendant increase of length, producing a bending of the sheet into the hot portion of the flame, where the hydrogen is instantly expelled from the palladium, which is forced to return to its original position from its natural elasticity.

It is now known that no absorption of hydrogen at atmospheric pressure by palladium takes place above 145° C., so that the cause of motion must originate at a comparatively low temperature. The question arises, Can palladium, under any condition of pressure, absorb hydrogen at a red heat in quantity at all comparable to what it can do at lower temperatures? If free hydrogen and palladium-hydrogen are compared as regards volatility, the one boils at 30° (abs.), the other at 420° (abs.), very much like two isomeric forms of the same substance. This ratio of 1 : 14 given (and certainly the ratio could not be made greater than 1 : 16, since the absolute boiling points may be taken as in the ratio of their respective critical points), we thus arrive at a hypothetical palladium-hydrogen critical point of 640° (abs.) or 366° C. An almost exact parallel may be drawn between palladium-hydrogen in its relation to free hydrogen and iridium oxide in its relation to free oxygen. Thus liquid oxygen boils at 90° (abs.) and the tension of dissociation of iridium oxide is 1 atmosphere at 1423° (abs.) The ratio of the absolute boiling points of liquid oxygen and the oxygen of iridium oxide are therefore as 1 : 15·9, which is almost the same value as that found above for the relative volatilities of hydrogen and palladium. In either case the ratio of the absolute boiling points of the respective substances may be taken as approximately representing the ratio of the latent heats of transition of state. It might then be possible that palladium no longer absorbed hydrogen under any condition of pressure. The present experiments were undertaken with the view of answering this question.

The diagram shows the general arrangement of the apparatus most suitable for examining the behavior of the metals like palladium, sodium, potassium, etc., toward hydrogen at high temperatures and pressures.



A rod of palladium, A, weighing about 119 gm., kindly placed at my disposal by Mr. George Matthey, F.R.S., was placed in a strong steel cylinder, D, having an accurately fitting conical joint. As little extra space as possible was left in the cylinder, which was heated in a bath of fusible metal, E. The vessel was connected with the manometer, B, by a strong copper tube, and the latter was similarly joined to a compressed gas cylinder, H, containing hydrogen. The apparatus, without the palladium, must be carefully tested at high pressures and temperatures. There must be no trace of a leak. An extra stop cock at C enabled the hydrogen accumulated in the apparatus to be blown off suddenly when required, after the hydrogen cylinder stop cock was shut off. Before commencing the experiments at high temperatures, it is well to charge the apparatus to a pressure of 20 atmospheres with hydrogen and then blow off the gas and measure it. In this way the volume of hydrogen that is absorbed for every diminution of the pressure of hydrogen is known. In the first experiments a pressure of 20 atmospheres of hydrogen in the apparatus corresponded to 780 c. c. of gas, measured at atmospheric pressure. When the fusible metal bath was heated to 420° and hydrogen at a pressure of 80 atmospheres introduced at starting, it fell to a pressure of 60 atmospheres in 2½ minutes. Blowing off the gas instantly to get rid of accumulated impurities and again applying a pressure of 80 atmospheres of hydrogen, the pressure was reduced to 60 atmospheres in 6 minutes. When the same operations were repeated a third time, the diminution of pressure by 20 atmospheres took 16 minutes, and a fourth operation required 28 minutes. In all, therefore, upward of 3,000 c. c. of hydrogen were absorbed in less than an hour. If the palladium could be seen at about a low red heat, then during the rapid absorption of the hydrogen as described in the last experiment, the temperature must rise very considerably, and the metal, during the operation, must actually appear to grow much brighter. Calculating from the tensions of the gas, the evolution of heat at 300° must be about 4,698 gramme units of heat per gramme of hydrogen absorbed. The reverse action would take place on reducing the pressure of hydrogen in the charged palladium. After the four charges the pressure remained constant at 80 atmospheres, no more hydrogen being absorbed. The hydrogen gas outside the palladium was now suddenly blown off, the stop cock shut, and the pressure allowed to rise from the escape of gas absorbed by the palladium. In this way it was noted that a pressure of 40 atmospheres was reached in half an hour. The whole amount of gas that had been absorbed by the metal was found, on measurement, to be 2,980 c. c. After the first charge of hydrogen the steel cylinder was opened and the palladium examined. It was found to have a deep rent in it extending along nearly the whole length of the rod. During the occlusion of the hydrogen the volume of the metal is increased by one-tenth, so that in the passage of hydrogen in and out of the metal enormous strains must be produced. As the volume of the original metal is a little less than 10 c. c., it may be taken that above 300 times its volume of hydrogen had been absorbed at the temperature of 420° and under a pressure of 80 atmospheres. The free space in the manometer and connections was now diminished, so that a pressure of 20 atmospheres corresponded to a volume of 300 c. c. of hydrogen instead of 780 c. c. as above. The palladium was saturated at 360° C. under a pressure of 80 atmospheres in the manner described above, except that a very much larger number of charges of hydrogen had to be employed. After saturation, the pressure of hydrogen was slowly reduced to 25 atmospheres; it rose to 30 atmospheres from gas passing outward from the metal, now heated up to 500° C., and finally reached 100 atmospheres; on cooling to 400° the pressure diminished from reabsorption of the hydrogen. On blowing off the gas between 400° C. and 500° C., 1,400 c. c. of free and 3,330 c. c. combined hydrogen were found. A rod of palladium, in this way, can be quickly charged with hydrogen at about 300° C. or 400° C., and as it is only the pure gas that is occluded, this process may be used as a rapid means of getting pure hydrogen in quantity for experimental purposes.

In the next experiment, the palladium was heated to 500° C. before any hydrogen under pressure was applied. No absorption was observed till the pressure of hydrogen reached 60 atmospheres. On charging as before at pressures between 80 atmospheres and 60 atmospheres, the metal was found to absorb 1,900 c. c. of gas. The experiment was repeated, with the difference that the charging pressure of hydrogen was raised to between 120 atmospheres and 100 atmospheres, and it was found that the palladium had now occluded 3,700 c. c. of hydrogen.

Thus it appears from these experiments that at 500° C. palladium can still occlude 300 times its volume of hydrogen under a pressure of 120 atmospheres. The observations on the tension of hydrogen in palladium by Troost and Hautefeuille showed that, for the same temperature, the values become constant and independent of the amount of occluded gas, only when the volume of hydrogen absorbed lay between 200 and 600 times that of the metal. Any other proportions gave variable tensions for the same temperature. The fact that 300 volumes can still be occluded at 500° C. seems to show that palladium and hydrogen, under such conditions, still follow the same laws of absorption as at lower temperatures. Nothing analogous to a critical point, where no combination takes place between the metal and hydrogen, has been reached.

Hoitsema published an important paper on palladium-hydrogen tensions in the Archives Neerlandaises, 1896, 30, 44. In this memoir, Hoitsema gives also a series of observations on the same subject made by Roozeboom. Taking the tensions given by the latter (simply because the curve seems more regular) for the horizontal portions of the dissociation curves at different temperatures, and calculating a Willard Gibbs' formula, from the following data, viz., 20° C. pressure 7 mm.; 100° C. pressure 205 mm.; 170° C. pressure 1,467 mm., the expression results (where T is the absolute temperature)

$$\log. p = 7{\cdot}00338 - \frac{1983{\cdot}4}{T} + 0{\cdot}2378 \log. T$$

From this it follows that the latent heat of dissociation of the palladium-hydrogen per atom of hydrogen in gramme-units is 4561 + 0·2378 T. This would seem to show the latent heat of dissociation increases instead of diminishing with temperature. In other words, the heat of combination should be rather greater at higher temperatures, instead of diminishing, as it must do if a point where no occlusion takes place were being approached. Thus theory and experiment would seem to agree.

The best and safest method for the experimental study of the relations of hydrogen and palladium at high temperatures and pressures would be to investigate the change of electrical resistance in a heated wire of the metal when subjected to different hydrogen pressures. The problem is, no doubt, more complicated. Still interesting results must follow from such an investigation. Some of the electrical properties of hydrogen and palladium at low temperatures have been determined by Prof. Fleming and the author, and the results will appear in future publications bearing on the subject.

The author is indebted to Mr. Robert Lennox for able assistance in the conduct of the experiments.

VISITS TO SCIENTIFIC INSTITUTIONS IN EUROPE.*

IN an emergency caused by a disappointment to your programme committee, I agreed to say something to you about some of my visits to certain scientific institutions across the water. That one which, if I could tell you the whole story, would perhaps be the most interesting of all to this audience was the Imperial Institute at Berlin, the Physikalisch-Technische Reichsanstalt. It was planned mainly by the great Hermann von Helmholz and was founded by a most noble donation from Siemens, whose name is well known to all electricians, as well as to other scientific men.

This institution is under the care of the government. It is, as its name declares, an imperial institute. Its duties are twofold, as the adjectives in its name may indicate. One part of its functions is the study of many refined physical problems, some of them too extensive or too costly to be dealt with by private means, or even by the semi-public means of the great German universities. Another important labor of the institute is the verification of almost any precise mechanism or apparatus submitted to it for the purpose.

In order to illustrate to you the extent and variety of the work done in the Reichsanstalt, I took the published list of the work accomplished by it during the year in which my visit fell, and began to copy the titles, but it is too long to read to you.

Among the more strictly scientific labors it was pursuing, I will name a few. It was engaged in measuring the expansion of water more accurately than had been done before. It was measuring the weight of a cubic foot of steam, with reason to hope that the accuracy attained would surpass that attained even by that great master of accuracy, the famed Regnault. It was studying the change of elasticity of a glass bar or tube caused by changes in temperature; its elasticity at the freezing point and its elasticity at the boiling point of water differ 10 per centum in some of the glasses which were used, and but 1 per centum in others. It had prepared a most elaborate normal barometer, and had compared with this the working barometer which is used for all ordinary purposes. It had made three series of measurements of the expansion of the three steel screws used in Fizeau's wonderful apparatus for measuring expansion. All this is work of a high order, and it is work very necessary to have done; and the Reichsanstalt has the facilities for doing it. They have a personnel of men competent to do it, and the superintendence of a man well fitted to lead in the doing it.

As a sample of the other kind of work done there, almost anything which you can mention as desirable to be verified can be verified there. They verify thermometers, or determine their errors and furnish a table stating what corrections are needed for these errors. They verify the accuracy of screws; the leading screw of a lathe, for instance, or the screw of such a micrometer as has been made by two of our past presidents for the Yerkes Observatory. They measure the expansion of steel bars designed to become scales by receiving an accurate graduation into millimeters or other lengths, or to be used in making an astronomical pendulum. Riffler, for instance, has had the expansion of the steel rods of his pendulums determined in the Reichsanstalt. They investigate alloys desired for special purposes, or required to possess certain specified properties. One gentleman desired an alloy which should have no magnetic properties, and the Reichsanstalt studied the matter and furnished such an alloy. They investigate gyrometers, instruments for indicating the number of revolutions of a rotating axis by a continuous indication. They verify tuning forks. If one is constructed to make 500 vibrations in a second, they can determine the actual number almost to the hundredth of a vibration in a second. They determine the durability of incandescent lights, and also their efficiency. All such questions and such forms of apparatus are submitted to the Reichsanstalt, and you would be surprised to learn for how small a fee the desired information is afforded. As you see, this is a pretty wide field of activity. In order to do such work, they employ a great number of trained scientific men. In Germany a trained scientific man will accept such a position, because it is considered honorable, and because it gives him a recognized and desirable social position. So the institution can command a high degree of talent and training for its work.

One day I met, in Berlin, two Americans whom I had the pleasure of knowing in this country, and we visited the Reichsanstalt together. That which most interested us was the magnificent institution as a whole. One most interesting apparatus was one designed for the establishment of a standard of light. You all know that it has been proposed that the ultimate standard of light for all measurements should be the light given out by a certain area of platinum at its melting point. It will probably be some time before this proposed standard can be conveniently and practically applied. The Reichsanstalt has suggested, and is trying to prepare, an alternative source of light designed as a standard for comparison in all accurate measurements. This standard is one in which a given area of platinum is heated, not to its melting point but to that temperature at which the quantity of light radiating from it and also passing through a given absorbent screen shall be precisely one-tenth of the whole energy radiated. Their screen consists of a tube closed at the two ends by plates of quartz of a determinate thickness, and filled with distilled water; and the standard of light which they hope to make practical is to be derived from a given area of platinum heated to that temperature at which this screen of quartz and water shall transmit one-tenth and absorb nine-tenths of the whole energy radiated. In the apparatus which so greatly interested me four different observers were to look, at the same time, at this source of light, each having his different measurement to make.

The apparatus, too, with which they compare thermometers seemed to me a most interesting apparatus. They have means for maintaining constant the temperature of a liquid medium in which they place a number of thermometers to be compared, and the apparatus will maintain some temperatures constant within one-hundredth of a degree for hours. Think of the skill, think of the apparatus required to do that, and then think of a building larger than our city hall filled with such skill and such apparatus, and you have a suggestion as to what this Reichsanstalt really is. . . .

The other institution in France which interested me was the International Bureau of Weights and Measures. Some twenty years ago, most of the governments of the larger civilized states united in appointing an International Committee of Weights and Measures, in the hope of preparing accurate copies of the meter and the kilogramme.

There is no measure of length, except the meter, which is not too ambiguous for general use. I once read a statement which had been copied from German into French, and then from French into English, which gave a certain length in inches and thousandths of an inch. I was interested to know the precise length intended. The question to be answered by conjecture was, What foot and inch were those used in the statement—the English (for the statement is now in English) or the Paris foot (for the statement was last in French) or one of the many various German standards of confused length (for the statement was first made in German, and almost every German petty state had its own contribution to the confusion of standards of length)? The only solution of the whole matter was that the truth could not be learned from the announcement, unless I could find whether the Austrian author had used the Austrian standard, or that of Heidelberg, where he wrote; or that of Leipsic, where publication was made; what course the French translator took and what the English. If Mr. Warner wrote the statement, and it was published in New York, conjecture would be safe; or if an Englishman wrote and London published. But when you consult the literature of precise measurements which is worth translating, the meter is the only standard of length which is not ambiguous, and the same is true of the kilogramme. How many different pound weights are there?

Now, as I said, the principal civilized governments united in forming this International Committee of Weights and Measures. This international committee, with the help of a French committee, have performed their task, and the mechanical and physical and practical work has been done a few miles from Paris, at Sèvres, in the Pavillon Breteuil, which was once a fine summer palace. This is now the home of the International Bureau of Weights and Measures. I went there one day, fresh from a long stay in England. In that country, if you desire access to almost any of the places which were likely to interest me, affidavits of respectability, in the shape of letters of introduction, are most essential, and I went to England in such health that letters of introduction were far from my thoughts. I went up to the high fence around the International Bureau without much expectation of getting access. In fact, one day I went there, and went away without even making application for admittance; but, on another day, as I approached the gate, a gentleman who had been standing there was just going away as he saw me. He courteously lingered, and turned back to the gate. I told him that I was a stranger, and that I had followed their work with great interest, and wished to see what could properly be shown to a stranger. I could not suppose that he had ever heard my name; but I do not know how a man could have received an acquaintance with more cordial courtesy than he showed me. He welcomed me; he introduced himself to me, and introduced me to the head of the bureau and to the third of the three scientific men of the establishment. Then the three took turns, each showing me that part of the equipment with which he was most conversant.

I saw nothing abroad which interested me more than this institution, but I could not hope to transfer this interest to you without diagrams and photographs. There was the comparer with which they have verified the length of those wonderful platinum-iridium meters, of which our own government has received two or three. I had seen the meters which our own government received. I had been invited to Washington, to be present when the standard meter was to be unpacked from the box in which it had been sealed at this International Bureau at Sèvres. The superintendent of the coast and geodetic survey, desiring to have some ceremony testifying to the importance of the event, had asked the heads of the bureaus at Washington whose duties made them interested in standards of length or weight, and the pre sidents of societies of engineers, and some of us plain professors also interested in such standards, and I had the honor to be among the latter. The seals were broken in the cabinet room by the President of the United States and his Secretary of State, and an instrument was drawn up and attested by the signatures of all the gentlemen present. That was my first acquaintance with the platinum-iridium standard meter of the United States, and it was most interesting to see the apparatus used in making it the most authoritative standard of length now existing within our country. I saw also at Washington the platinum-iridium kilogramme which had also been sealed up at Sèvres and sent to this country and opened at the same time.

On my visit to Sèvres I saw a most consummate flower of mechanical skill in the four balances with which the work on that kilogramme and on the smaller weights, required in the investigations, had been accomplished. These were balances nearly like the one which I used for some time. They have brought a new precision into the art of weighing. I suppose scales which weigh a ton of coal within ten pounds are as accurate as commercial scales of that capacity need to be. Now scales weighing a ton of coal would have to indicate the difference produced by adding to their load a piece of writing paper a quarter of an inch square, in order to equal, in precision and delicacy, the four balances which I saw at Sèvres. One illustration of their accuracy has been mentioned several times. I have mentioned it in this place. I may remark that I once heard this illustration repeated, to my no small amusement. I sat at a banquet and heard a physician of this city tell of a wonderful balance in one of the departments at Washington, which had the degree of accuracy which I will mention shortly, and I sat pleased and silent, for that balance was in my laboratory, and there was none at Washington.

The story which the physician told was this: These balances are so delicate that, if you first put two one-pound weights side by side on one pan and counterpoise them, then if you put one of the two weights on top of the other, the counterpoise will be too heavy, for one of the weights is now farther from the center of the earth than before, and the action of gravity on it is lessened. Such a difference as this is quite within the delicacy of the instrument. I do not mean to say that one, or even ten, weighings would be sufficient to determine so small a difference. It is to be detected only by long and painful labor. But the error produced by weighing two pound weights, sometimes side by side and sometimes one upon the other, is a quantity capable of being detected by this balance, and it is a quantity which is to be considered in the reduction of all weighings made with it.

There was a barometer there the like of which has not been produced elsewhere, and an air thermometer like the barometer. Regnault said, some fifty years ago, that between the freezing and the boiling point of water it was hard to measure a temperature much closer than a tenth of a degree. And he was right. But the Bureau at Sèvres has labored at this matter until, within those limits, it is possible to measure to the hundredth of a degree more accurately than to the tenth of a degree fifty years ago. A great increase of our knowledge of the behavior of materials will thus result from the investigations at Sèvres. . . .

One matter of which I wish to speak is the Royal Institution in London. If there is any place in London in which an American ought to feel at home, it is the Royal Institution. It was founded by an American, Benjamin Thompson, afterward Count Rumford, of the Holy Roman Empire. I do not know what was his precise aim. The institution is now somewhat unique. It is in some sort a scientific and literary club. Any one seems to be elected to membership on application, I think as freely as he could be admitted to our Case library on paying his fee. The building has a library and a pleasant reading room, well supplied. It has also a good many Americana, including letters from Franklin and Washington, as well as other matters especially interesting to Americans. It has also important laboratories, in which some of the most memorable work yet done in science has been accomplished. You will agree with me when I recall to your minds that here Sir Humphry Davy worked and here his greatest discovery succeeded him in the person of Michael Faraday. At the present time Dewar is professor of physics here, and Lord Rayleigh, the discoverer of argon, is professor of chemistry. Lord Rayleigh's work is done at his private laboratory, an hour from London, which of course I could not see. . . .

One other place which I visited in London was the office of the Warden of the Standards. London is a place which has grown. There is but little there which was built to order for its present use, one is tempted to think. Things are not often torn down in London; they are strong and lasting enough to be used for another purpose. And this Bureau of Weights and Measures, the office of the Warden of the Standards, was most interesting for this reason. One of the rooms in which standards are kept which have come down from the time of Queen Elizabeth is a chapel which is 600 years old. The very word "old" has a different meaning in England from that which it seems to possess in this country. Here the word "old" carries with it the suggestion, "Throw it away; get something new." With them the feeling is, that what is old is sacred, endeared, consecrated. The phrase "old fellow," as a term of endearment, was not invented on this side of the water. There it is at home; it is appropriate. I soon began to feel that there is no hope of salvation for a man in England who goes to a church less than 200 years old. In that old and venerable chapel, worthy of veneration, the old pound weights, the old gallons of Queen Elizabeth's time, seemed consecrated; seemed to have a glamour of romance and poetry about them. I never knew, till after visiting such scenes and seeing in them these special objects, how the meaning of the English language may change with change of longitude.

* Extracts from a paper by Prof. Edward W. Morley, Ph.D., LL.D., before the Civil Engineers' Club of Cleveland, and published in the Journal of the Association of Engineering Societies.

APPROPRIATION OF FREE ATMOSPHERIC NITROGEN.

NITROGRADSKY is, on account of his extended and thorough studies of micro-organisms, well known in connection with the subject of nitrification. He has now given the result of his studies on the above topic. In isolating these organisms, he used what is by him termed the "elective" method of isolation. In this special case a culture medium was employed that was free from all combined nitrogen. It was made up as follows: Distilled water, 1,000 c. c.; 20·40 gr. dextrose, 1 gr. potassium phosphate, 0·5 gr. magnesium sulphate, 0·01 to 0·02 gr. potassium chlorate, sulphate of iron, sulphate of manganese. This culture medium was then inoculated with garden earth. Most of the cultures soon showed evidence of butyric acid fermentation. Gas bubbles appearing in the immediate vicinity, small masses floating in the medium. These masses somewhat resembled kephir grains. This fermentation continued till all of the sugar was used up. After this fermentation, mould developed on these white grainlike masses, followed by algæ. It appears that this medium, at first wholly unsuited for higher plants, because of the absence of nitrogen, was made suitable when appropriation of nitrogen by bacteria had taken place. The kephirlike masses consisted of a species of Clostridium, to which he has given the name of C. pasteurianum, and two kinds of bacteria forming threads. The interesting details cannot be given here. Suffice it to say that this Clostridium is capable of obtaining nitrogen from the atmosphere, which is found in the medium in part as soluble inorganic nitrogen, but mostly as insoluble organic combined nitrogen.—Archives des Sciences Biologiques, St. Petersburg.

There are horses enough in the service of the street cleaning department of this borough of the Greater New York to supply the requirements of the cavalry service of some European governments, and the expense for fodder in a year is large. These are the quantities needed for 1898: Nine hundred and five thousand pounds of prime hay, 77,000 pounds of rye straw, 1,625,000 pounds of white clipped oats, 80,000 pounds of bran, 3,700 pounds of salt, and 2,500 pounds of oil meal.

ST. NICHOLAS DOCK.

MILITARY OF HAYTI.

CAPE HAYTI.

HAYTI.

THE trouble which was caused this winter by the imprisonment of a German subject in Hayti has again attracted attention to that republic, and therefore we think, in spite of the all-absorbing condition of affairs in China, that some of our readers may be interested in the following account of the island and its inhabitants and in the accompanying engravings, for which we are indebted to our worthy contemporary, the Illustrirte Zeitung.

Hayti is a most interesting country to one—especially if he is a foreigner—who knows that he will be able to leave it whenever he chooses to do so. Here he can at least learn how a state should not be governed. There are laws enough, certainly; a great "Penal Code," a greater "Civil Code" and other beautiful, thick books, all modeled after the best French patterns; there is an army, innumerable generals, judges, a police department and there are even schools. But all this does very little toward making Hayti a civilized country. Corruptibility, hatred of foreigners, laziness and rudeness characterize the officials from the highest down to the lowest. Each one seeks to fill his pocket while his good fortune lasts, or to vex and injure the hated whites, who, he thinks, take the money from the country. Whenever there is a change of minister, and this happens very often, all friends and favorites of the new candidate hasten to the capital with the hope of being able to secure some little office, something in the custom house, if possible. "The old custom house officials have made enough," they say, "it is time that we had a 'job'"; and the new minister chooses carefully from among his friends when he has to appoint a director, an inspector, or comptroller of the customs. "Enrich yourself, but do not allow yourself to be caught!" is the advice that the fortunate favorite reads between the lines of his conversation about "new eras," "the good of the country," and "glorious forefathers." Under such circumstances the condition of the finances and of the national credit can easily be imagined.

On the other hand, Hayti is a paradise of beauty; its irregular ranges of volcanic mountain formations produce grand mountain scenery with lovely valleys through which innumerable streams flow, enriching the ground so that we find here an abundance of vegetation such as is found only in the tropics, in spite of the fact that it has not been tilled for a hundred years, and here slumber deposits of valuable minerals, but no attempt has yet been made to get them out. If the traveler rides inland for a distance, his eye meets new beauties at every glance. Sometimes the road leads over turf-covered savannas, sometimes along a river on the banks of which grow bamboos as thick as a man's body, cocoanut palms, and mahogany trees, all as the caprice of nature has placed them. In and out through this growth flit iris-hued humming birds and brilliant butterflies, but very few parrots will be seen, and no apes. He is captivated by the group of white-leaved baobal trees near every peasant's hut, and the gigantic mango trees invite him to rest in their shade and enjoy their succulent fruit.

Everywhere we have the mountains covered with thick forests, even close to the sea, and one who has approached the coast of Hayti at daybreak will remember with delight the brilliant coloring of the picture and the noble line of the mountains reaching heavenward and mirrored in the blue sea, through the smooth surface of which the steamer cut long furrows. Gradually the sun rose, gilding the peaks of the irregular mountain range and throwing slanting rays into the valley, in which the slender palms are swayed gently back and forth by the sea breeze. Dwellings are scattered on every side, over the mountains, for that is where the Haytian peasants like best to live, so that the population of the seaports is very small compared with that of the country. But if any one believes that these negroes will cultivate the land to raise coffee, sugar cane, tobacco, rice, or other crops that would grow most luxuriantly if they received any attention, he is much mistaken. Since their glorious deliverance from the rule of the French, under the leadership of Toussaint l'Ouverture, in the beginning of this century (1804), the negroes have rested on their laurels and lived on the results of the work done by their ancestors, but they go in crowds to the nearest market to sell their few pounds of coffee that has grown near their "habitations" without any effort on their part, or a handful of pimento or fruit. They are most unpretentious in regard to their food. The menu of a Haytian consists as a rule of rice with red beans, codfish, or simply a piece of sugar cane with a few mangos, and on festival occasions bouillon, called by the Spaniards "sancoche." A dinner with a Haytian host would offer little that would suit the palate of a foreigner. After having refreshed themselves with plenty of rum and tafia, the peasants start in the evening for their homes—often hours distant—in long, picturesque caravans, men, women and children on foot or on donkeys, carrying in their saddle bags of woven bast the things which they have bought, such as meal, rice, codfish, herrings, cloth, and kerchiefs. They develop such sharpness in trade as a newly arrived German would never dream of; they handle and try the goods, seldom allowing themselves to be deceived by any "puffing," and then they haggle over the price.

Once back in their wilderness, they lounge about all day long, but when night comes they gather together in secret places in the woods, safe from the sight of the hated whites, where they carry on their Wudu dance. This dance is of African origin and was brought to Hayti by the negroes of the Gold Coast, the ancestors of the present inhabitants. The dance is preceded by the sacrifice of a goat or a white fowl, and the blood of the victim is mixed with tafia and drunk by those participating in the ceremony, who then begin to dance with an indescribable excitement to the monotonous beating of a drum, and they dance until they sink to the ground exhausted. The feast is presided over by the papaloi and the mamaloi, who are treated with the greatest respect. It is claimed that human victims are sacrificed on special occasions. Cannibalism is common in the interior of the island, and when the last president, Hyppolite, died, it was stated that he had been a Wudu priest and an anthropophagite. Two men were executed during the last year, in Port de Paix, on the charge of having killed and eaten their own fathers.

These conditions—and there are none worse in the interior of Africa—are brought into juxtaposition with the boundless conceit and the coquetting with culture of the Haytians in the large seaports. When the mercury stands at 122° Fahrenheit in these towns, one sees young negro dandies dressed in high hats and long heavy overcoats such as they wore in Paris, where they were sent to be educated. The good people of Port au Prince thought it necessary to have a market hall, a steam street railroad, electric lamps and an ice factory, so as to be able to say, "Nous marchons avec la civilization" (We progress with civilization). The only pity is that the market should not be held inside instead of outside of the market hall, that the electric lights will not work, and that the ice factory had to be closed for lack of consumers who could pay for the ice.

A stranger who lands in Hayti will have to submit to many restrictions; he will not dare to live away from the open ports—Fort Liberté, Cap Haitien, Port de Paix, Gonaïves, St. Marc, Port au Prince, Jérémie, Aux Cayes, Aquin and Jacmel; he cannot own land nor even carry on a small business. If he desires to buy produce he must employ so called "speculateurs," who buy from the inhabitants and then deliver the produce to the white merchant after they have taken their own profit. The merchant is obliged to make a contract with the "speculateur" before he can buy coffee or logwood, and the "speculateur" makes his contract with the peasant who agrees to bring him the produce. The result is that the peasants and the "speculateurs" are always in debt to one another, and the credit of the country is rotten from the foundation up. The revenue consists of customs duties; and the export duties have to be paid in American gold, while the import duties are paid in the national money. On account of the corruption of the custom house officials, only a part of these duties reach the treasury, the merchant and the officials sharing the "job."

What the fate of this negro republic will be when the resources are exhausted and the state is bankrupt no one can tell! But it is certain that Hayti has run down very fast during the last few years, so that the catastrophe must come soon. This island, so blessed by nature, can never know prosperity until the negroes shall decide to cede property rights to foreigners, and until then it will be impossible to count Hayti among the civilized lands of the world.

RUINS OF SANS SOUCI CASTLE.

Contracts for building the largest movable bridge in the world were let January 11 by the Chicago Sanitary District. The bridge, which will cross the channel just south of Thirty-first Street, will have the great length of 410 feet, a width of 116 feet, a weight of 3,800 tons, and will cost $225,000. The King Bridge Company, of Cleveland, was the successful competitor. It will be an eight-track structure, and will be used by the Union Stock Yards and Transit Company, with two tracks; the Chicago and Northern Pacific, with two tracks; and the Pan Handle, with four tracks. The bridge with which this new structure may best be compared is that of the New York Central across the Harlem. The Harlem bridge provides for but four tracks, and has a weight of but 2,000 tons.

ENGINEERING NOTES.

By May 1, the Congo Railroad between Matadi and Stanley Pool will be completed and open for traffic. In the middle of December the rails had been laid for 348 kilometers of the 388 covered by the line, the roadbed for 10 kilometers more was finished, and men were at work on the next 10 kilometers, bringing the line to within 13 miles of Stanley Pool. The iron bridge over the Inkissi will be put in place at the beginning of January. The November receipts from traffic on the part of the road in operation were 200,000 francs.

The Northern Pacific has an interesting feat of engineering in hand in connection with the big Missouri River bridge, at Bismarck, N. D. The bridge is one of the largest in the country, resting on three piers. The east pier has slid from its original location a distance of several feet, owing to the sand shifting beneath the foundation. Laborers are constructing a new foundation at a depth of 70 feet beneath the level of the river, and the entire pier, weighing about 2,000,000 pounds, will be moved bodily from the old to the new foundation. The bridge will be supported by temporary trestlework while the operation of moving the pier is in progress, and the work of removal will, it is said, be accomplished in a few minutes, without any material delay of traffic.

Steel and iron in the form of strips or of wire netting combined with concrete have for long past been used for constructive purposes. In San Francisco expanded metal and concrete have recently been used as a foundation for paving in some of the principal streets, and excellent results are anticipated. The surface earth of the street is first shaped and covered with a bed of sand. On this sand are laid the sheets of expanded steel, and over the steel is a layer of concrete, which is stamped into the meshes of the metal, forming a perfect bond. This makes a foundation upon which can be laid asphalt, bituminous rock, basalt blocks, wood blocks, brick or any kind of surface pavement desired, the permanency of the entire pavement depending entirely upon the character of the top work.

The subway ordinance introduced recently has behind it a company headed by George W. Jackson, who has built most of the subways of Chicago. In exchange for carrying the city's water mains and electric wires the ordinance carries a franchise covering the city between the lake, Ashland Avenue, Division Street and Twenty-second Street. The company proposes to put down a subway in each street of the district sixteen feet square in which to carry every water and gas main, all electric light, telegraph, and telephone wires, and all pneumatic tubes. The corporations now using space under the city streets are to rent space in this subway and save the sums they now spend every day for tearing up and replacing the pavements. It is estimated that the building of the subways would take seven years, and would cost about $20,000,000.

A long felt desideratum in railway mechanics has lately been filled by a simple arrangement originating with F. R. Coates, roadmaster of the "Consolidated" system, namely, a method for putting a switch track around a wreck in quick time. The peculiar feature in this case is in the frogs. These connect the temporary crossover with the main tracks without cutting a rail or a tie or pulling a spike; they are mortised into the main tracks, and when the wheels of the train which is to cross over touch them the train is raised up above the level of the main tracks, and passes over as smoothly as though the rails were cut and an ordinary switch inserted after many hours of hard labor by a hundred or more men. Thus, if the right-hand track is blocked, trains may pass the wreck by being switched over to the left-hand track, or if the circumstances are changed, that is, if a train wants to run in the opposite way, on the left-hand track, the frogs of the crossover may be taken out in a moment to let it pass, and put back in an equally short period.

An improved process in steel casting, applicable to large or small guns, engine cranks, railway wheels, propeller shafts, etc., the invention of Ellis May, is described at much length in The Pall Mall Gazette. The design of the inventor is to meet or prevent those hidden flaws in steel which so often produce bursting and fracture. The plan is to make the castings in an airtight chamber from which all air is exhausted, the mould or casting being placed in the chamber before the exhaustion of the air; this chamber is surrounded by a series of other chambers, each connected with the central chamber by a pipe controlled by valves, and in these chambers a reserve of vacuum is stored, the air from them being exhausted by vacuum pumps. When a casting is ready to be run in, the controlling valves are opened and the residue of air in the casting chamber is instantaneously sucked out into the surrounding chambers at the same moment that the molten steel is poured into the mould; the casting thus takes place in vacuo, that is, the secluded air and gases rush out of the fluid metal and diffuse themselves in the vacuum chambers, and a flawless, homogeneous steel casting is the result.

A method of preserving boilers not in use has been prescribed for the French navy, says The Engineering and Mining Journal. According to this the boilers are completely filled with fresh water, and in the case of large boilers with large tubes there is added to the water a certain amount of milk of lime or a solution of soda; in the case of tubular boilers with small tubes milk of lime or soda is added, the solution, however, not being so strong as for the larger tubes, in order to avoid any danger of contracting the effective area by deposit from the solution. The strength of the solution is to be just sufficient to neutralize any acidity of the water. Care is enjoined to be taken to preserve the outside of the steel or iron tubes in those boilers which are not to be used for long periods; such are for this purpose painted with red lead or coal tar as far as it is possible to reach, while for those portions which are inaccessible a protective coating is obtained by burning under the tubes a certain amount of tar or coal tar, the smoke of these forming a coating of soot, which prevents the air from reaching the surface of the tubes. Besides this treatment, the boiler casing is closed and kept airtight, after some quicklime has been placed inside. Periodical inspections of these boilers are made to insure the complete filling of the tubes.

MISCELLANEOUS NOTES.

An enterprising cyclist of Berlin, Germany, has secured the permission of the city authorities for establishing bicycle racks at different points of the town. Each stand will have a lock the key of which can be removed by the cyclist only after inserting a nickel in the slot. It is stated that about a thousand of these apparatus will be furnished by the inventor to restaurants, cafés, theaters, etc.—Le Chasseur Français.

Under the heading of "Carrying Coals to Newcastle" The Pall Mall Gazette says: "The purchase of American cotton for Bombay is a novelty that is deserving of notice. It has been brought about by the low price of the American staple as compared with that of the intrinsically inferior broach. It is well for the Indian ryot that his country is rather far removed from the United States, otherwise, in a productive year in this last-named land, he would find himself deprived of all return upon his investment and his labor. It is pointed out that the comparatively high rates for Indian cotton are not due to any anticipation of small harvests, for as a fact the yield promises to be 150,000 bales greater than was the case last season."

The animal charcoal which is used for the purification of sugar gradually becomes impregnated with salts, oxides and vegetable matter, which fill the pores and render the charcoal useless. In order to restore the coal, we wash it with hot water and heat it in closed retorts. The latter treatment partakes of the nature of a distillation. The treatment is only partly successful, and many improvements have hence been suggested. What Johann Lux, of Vienna, proposes, is also only an improvement. His chief novelty is a horizontal iron drum, up to 7 feet in diameter and 10 feet in length, forming a screw conveyor on its inside. The washed and dried charcoal is introduced at the one end and slowly conveyed to the other, and hotter, end, a brisk air current being maintained through the drum. It is said that the conditions are so favorable for the complete oxidation of the impurities that the temperature at the far end of the drum, which is surrounded by flues, need not be raised beyond 250° or 300° Cent. (480° or 570° Fah.), and this for a few minutes only. At higher temperature the carbon of the material would itself be attacked; a slight loss of this kind may, however, have to be borne.

It is evident from the tenor of a report submitted to the State Department by the United States consul at Ghent that the opposition in Europe to American products has not abated in the least. According to this report, Belgium has issued another order making a further discrimination against American meat products. The order relates to the inspection of fresh and other meats imported into Belgium, and the new regulations will be more severe than heretofore. A minute examination of all packages containing these meats is to be made at the ports of arrival, at the frontier towns or at certain interior ports of entry designated by special decree. The consul, Mr. Morris, says that it is reported that the order is to be especially aimed at ham, bacon and pork products shipped from America to Antwerp. A fee of about 1½ cents a hundred pounds is to be charged for the service of inspection. The United States supply nearly all the pork used in the cities of Belgium. The quantity of miscellaneous meats, including hams, beef, tongues and salted and smoked bacon, imported into Belgium in 1896 amounted to 43,150,270 pounds, valued at $2,649,818. Of this the United States sent 35,980,137 pounds, worth $2,109,507.

Chief Engineer G. W. Baird, of the Navy, on duty as superintendent of the State, War and Navy Department Building, has submitted to the Secretary of the Treasury an estimate of $1,983 for erection of fireproof sheds in the courtyards of that building to protect and shelter two thousand five hundred bicycles. During the last year over a thousand wheels used by officers and clerks employed in this building have been accommodated daily in the corridors when it rained and in the courts when the weather was clear, stands being provided for the support by popular subscription. Recently, however, when the street railway system of Washington has been paralyzed on some lines, the number of bicycles in the corridors has become a nuisance, yet the authorities recognize them as the only possible conveyance for those who live at a considerable distance from their offices. Chief Engineer Baird, who has investigated the matter thoroughly, has found that the habitual cyclists in the departments—those who use the wheel altogether in getting to work and home again—are the persons who secure least sick leave, and who are earliest at work in the morning and are the ones from whom the government is getting the highest services. So he declares that it will be a great economy to offer them every inducement to ride their wheels to the departments with the assurance that they will not be ruined or stolen during office hours.

Researches of a somewhat lengthy description, which have been carried out at the Liverpool Research Laboratory, involve the use of calcium carbide as a metallurgical reducing agent. In the first instance, an excess of litharge was heated to redness in contact with the carbide, in a clay crucible, the reaction being accompanied by vivid incandescence, resulting in the formation of metallic lead and calcium oxide CaO. A further portion was now selected, in which the proportion of carbide exceeded that of the litharge; this was further subdivided into various smaller portions, each portion being exposed to various temperatures, resulting in a regulus of calcium and lead of various percentage, together with the expulsion of CO_2. The alloys thus formed, says Acetylene Gas Lighting, are all more or less brittle, and, to a certain extent, sonorous when struck, their melting point ranking below that of pure lead, and are slowly but completely decomposed in contact with aqueous vapor, the reaction being much less energetic than that afforded by alloys of lead with the alkaline metals. Stannic oxide, cupric oxide, and also ferric oxide, at corresponding higher temperatures, were readily reduced, yielding results of no practical value, in the case of the cupric alloys those samples containing under 1 per cent. of calcium being rendered cold-short, and breaking under very small strain; while, on the other hand, iron containing calcium approaches in appearance that of ferromanganese, being even more brittle, and very oxidizable, in contact with water.

SELECTED FORMULÆ.

Phosphorus Rat Pastes.—

1. Phosphorus	2	ounces.
Carbon bisulphide	2	"
Lard	1	pound.
Wheat flour	1½	"

Dissolve the phosphorus in the carbon bisulphide; add the lard and then incorporate the flour.

2. Phosphorus	6	ounces.
Sulphur	1	"
Mustard, powder	2	"
Sugar	8	"
Rye flour	12	"
Water	16	"

Mix the phosphorus and sulphur with 6 ounces of water, triturate until liquefied; add the mustard, sugar and flour and the remainder of the water.

3. Phosphorus	1	ounce.
Bisulphide of carbon	1	"
Lard	8	"
Wheat flour	12	"

Dissolve the phosphorus in the bisulphide of carbon, add the lard, and lastly make a uniform paste with the flour. This paste is said to not ferment or spoil.—Pharmaceutical Era.

Storbeck's Depilatory.—

Alcohol	12	grm.
Collodion	35	"
Iodine	0·75	"
Essence of turpentine	1·5	"
Castor oil	2	"

Apply with a brush on the affected parts for three or four days in thick coats. When the collodion plaster thus formed is pulled off, the hairs adhere to its inner surface.—Nouv. Rem

Mustache Fixing Fluid.—

Balsam of tolu	1 part.
Rectified spirit	3 fluid parts.
Jockey club	1 fluid part.

Dissolve the balsam in the liquids. Put up in small bottles with a brush attached to cork. Apply a few drops to the mustache with the brush, then twist into the desired shape.—American Druggist.

Red Varnish for White Metal.—

	Parts by Weight.
Seed lac	20
Powdered sandarac	11
Turmeric	5
Essence lavender	3
Red sandalwood	3
Alcohol	140

Reduce all these solids into very fine powder and dissolve them in the alcohol, either over a water bath or over a sand bath, the latter being preferable.

Yellow Varnish for White Metal —

	Parts by Weight.
Gum lac	100
Small mastic	80
Venetian turpentine	76
Dragon's blood	45
Gamboge gum	50
Alcohol	1500

Proceed as in the receipt above.

Waterproof Cement.—

	Parts by Weight.
Bichromate of potash	8
Gelatin size	11
Alum	1

Dissolve the gelatin in a little water, then add the bichromate of potash and the alum. This glue or cement resists water at all temperatures.

Cement for Metals.—

	Parts by Weight.
1. Boiled linseed oil	6
Copal	6
Litharge	2
Powdered white lead	1
2. Slaked lime	1
Brick dust	2
Boiled linseed oil	3

Make a thoroughly homogeneous mixture of the ingredients.

American Cement.—

	Parts by Weight.
India rubber	10
Chloroform	6
Mastic	2

This size is also good for making glass adhere to other hard surfaces.

Bath Tablets.—C. O. B.—The proprietary article is a composition of sodium carbonate and tartaric acid made into tablets and perfumed. The following formula will yield a satisfactory article:

Sodium carbonate	2	ounces.
Tartaric acid	¾	"
Powdered soap	60	grains.
Perfume	q. s.	

Thoroughly dry the soda and acid separately and mix well. Incorporate the perfume with the soap and gradually add the soda and acid. Then make into tablets secundum artem. The following forms a nice perfume:

Oil nerol	1	drachm.
Oil bergamot	2	"
Oil cedrat	1	"
Oil lavender	2	"

To Render Brass or Nickel Fixtures Iridescent.—To give a beautiful iridescence to nickel, brass or copper fixtures, prepare a solution of 1 part of lead acetate to 3 parts of sodium hyposulphite in 48 parts of water and into this plunge the articles and let stand. Remove from time to time, and as soon as the requisite depth of color is obtained, rinse off and let dry spontaneously. The iridescence is very beautiful and quite lasting

Substitute for Fire Grenades.—A common quart bottle filled with a saturated solution of common salt makes a cheap and efficient substitute for the ordinary hand grenade. The salt forms a coating on all that the water touches and makes it nearly incombustible.

HINTS ON THE BRUSH DEVELOPMENT OF PLATINUM PRINTS.

By T. PERKINS.

IT is somewhat strange that so many photographers develop their prints on AA and CC paper by flotation, when the method of developing with a brush has so many advantages. In this article I intend to set out the method of procedure I now follow, as the result of several years' experimenting with these excellent papers.

I make up a saturated solution of oxalate of potash, which will keep indefinitely. I put into a wide-mouthed bottle, which, when the solution is made, I keep well corked, enough of the crystals to about fill one-quarter of the bottle, and pour upon it enough boiling rain water to nearly fill the bottle; by shaking and stirring this I quickly dissolve the crystals and then set the solution aside for use as required. When I have any printing to do, I pour equal parts of this stock solution, pure glycerine and hot rain water into a measure, making up as much as I think will be sufficient for the work I have to do; I stir the mixture so as to get the whole intimately mixed. I prepare three dishes of hydrochloric acid clearing solution, and lay a sheet of clean glass on the table of the room lighted by ordinary daylight, but with the blind drawn down if direct sunlight would otherwise fall on the table. Then I begin printing, and as each print comes out of the printing frame, I proceed to develop it at once. I pour out a little of the mixed developer into a saucer and thoroughly saturate with this the developing brush—a "mop" is the kind I use for any prints up to 12×10, the largest that I ever have occasion to develop—and rapidly, though steadily, moisten the surface of the print by strokes of the brush drawn from left to right lengthwise along the print previously laid face upward on the sheet of glass, each stroke overlapping the one previously made. I do not as a rule find it necessary to rewet the brush, though this is recommended in the printed instructions furnished by the Platinotype Company. As soon as the whole surface of the print has been wetted, I cross the strokes so that the whole of the print is uniformly moistened, and then watch the development, which, owing to the presence of the glycerine in the developer, proceeds slowly. If the print develops as it should do, I wait till the desired depth of tone is reached and then put it face downward into the first clearing bath; then I wash the brush in a cup of hot water before using it again for another print. By this means the developer is kept clean and the prints are kept bright, for I find a dirty brush tends to degrade the purity of the lights. If another print is ready for development, I proceed to develop this in like manner, pouring more solution from the measure into the saucer when required, and when these prints have been in the first clearing bath from five to ten minutes I transfer them to the second dish, and after a like interval to a third, where they remain until my printing is finished and all the prints have been at least twenty minutes in the last clearing bath. I then throw away the first and second clearing baths, often keeping the third to be used as the first when next I print. The prints on removal from the last clearing bath are washed well in several changes of water and then either dried by artificial heat or are allowed to dry of themselves, spread out on a cloth or sheets of blotting paper.

This method of development allows various modifications to be made to suit the subject, a few of which I will now enumerate.

If the print is under-exposed and lacks vigor, it may often be saved by holding it, as soon as it is well wetted, over a stove or before a bright fire, so as to heat the solution on its surface up to boiling point. This will bring out the print, but in order to be successful the heating must be done before the yellowness has disappeared from the paper.

If the print has been over-printed, I add a considerable quantity of glycerine to the developer in the saucer. This still further slows the process and enables me to remove the print to the clearing bath before it has become too dark. If certain parts of the print require retarding, I begin with a solution strong in glycerine, and with another brush dipped in a solution of strong oxalate paint over the parts which I wish to bring up. If I want to entirely stop the development of any part, I do this by applying some of the clearing bath with another brush.

I have sometimes found that by brushing over the whole print, when dried and mounted, some diluted water color megilp, to be obtained of any artists' colorman, the brilliancy of the print is improved. The same may with advantage be applied, in a stronger form, to any parts that have a rusty brown appearance from solarization.

The plan of developing print by print, as they come from the printing frame, is much better than the plan I formerly adopted of finishing the printing of the whole batch before developing any, as it enables me to make any needful alteration in the exposure of a second print if the first is not satisfactory; whereas if all are printed before any are developed, the whole number of prints from the same negative will probably have the same defects. The fact that the cool bath development allows this method to be used is one of the great advantages it possesses over the old hot bath system, and another is that it can be carried out in places, such as my present abode, where gas for heating a stove cannot be procured.

I have not touched upon the modification of color, which may be obtained by rendering the developer alkaline by the addition to it of some carbonate of soda, or by adding to it some of the bichloride of mercury bath used in the intensification of negatives, either of which will give the print a brown tone, more and more pronounced as more and more of these solutions are added to the developer.—The Practical Photographer.

The Amateur Photographer says: There is an interesting article by Rev. J. Beanland on "Modifications in Platinotype Developers" in The Photographic Times (New York), the gist of which we give below.

The Rev. J. Beanland is well known in the North of England as quite a local oracle on all matters connected with platinotype, and months ago it was said that Percy Lund & Company would shortly publish a handbook on platinotype, for which we have been looking forward ever since.

We are glad to find Mr. Beanland joins us in the assurance we have often given that platinotype printing is not nearly so difficult as some seem to imagine. He says:

Many amateur photographers are afraid to try their hand at platinotype printing because they imagine it is one of the most complicated printing processes; whereas, in reality, it is one of the simplest, and by a little modification of the developer, the novice need not have any failures.

It will be the purpose of this short article to show how within certain very wide limits successful platinotype prints may be obtained from—(1) Negatives of very extreme contrasts. (2) Negatives lacking contrast. (3) Over-printed proofs. (4) Under-printed proofs. Before doing so we will give the standard developer which, in the majority of instances, will produce successful results. As regards its working, we will refer our readers to the directions obtainable from the makers.

The standard developer is made by adding two parts of water to one part of strong oxalic solution composed as follows:

Potassium oxalate	1 lb.
Water	54 oz.

When this developer is to be applied with a brush, it is desirable to add an equal quantity of glycerine to the developer.

Negatives of very extreme contrasts are developed as follows: Apply a little glycerine over the parts most deeply printed. Heat a little of the strong solution and apply with brush to the parts which are least printed. Then apply the developer as given above, disregarding the developer or glycerine previously applied.

A little practice will enable anyone to develop a print from a negative with extreme contrasts, in such a way that the contrasts have been subdued, and an even, well-balanced picture is the result.

Over-printed proofs may be saved, even when almost printed out, by developing with the following solution:

Strong solution.
Water.
Glycerine.

If the proof is only slightly over-printed, the quantities of water and glycerine must be reduced.

Negatives which have very little contrast are best printed very slightly indeed. In fact, we only print such negatives far enough to get the details of the landscape, etc., out, and the high lights absolutely unprinted. After fixing and thoroughly washing, we intensify with the platinum intensifier given below.

Under-printed proofs are very easily intensified with the same intensifier. The resultant image being platinum, we are inclined to believe the results are absolutely as permanent as if made in the usual way on platinotype paper.

PLATINUM INTENSIFIER.

I. Sodium formate	48 gr.
Water (distilled)	1 oz.
II. Platinum perchloride	10 gr.
Water (distilled)	1 oz.

For use mix

Water	1 oz.
No. 1	15 minims.
No. 2	15 "

BROMIDE PRINTING.

By R. T. COLLINS.

NOW that the evenings are short, a good many will find it hard to get their printing done. Now is their time to make use of the excellent qualities of bromide paper. Bromide paper has of late been in such great demand that nearly all the principal plate firms have added this requisite to their list of goods. Instead of the old greasy surfaced bromide paper, we have now paper with a beautiful platinomatt surface indistinguishable from the best platinotypes, besides which are novelties such as bromide cards, ennamo bromide, tinted bromide, etc., so that everyone's taste is suited. But whatever brand of bromide paper is selected, the working of it is practically the same for all. Having selected his brand, and purchased a packet of paper, the next thing the operator has to do is to select suitable negatives. Negatives best suited to bromide printing are of medium density with plenty of detail. Having selected his negatives, the operator retires to his dark room, and by the light of the ruby lamp opens his packet of paper, and withdraws a sheet, and places it film downward in a printing frame against the film surface of his negative, as one would do in ordinary silver printing. To find the film surface of the bromide paper (a thing usually difficult to beginners, on account of the film surface being in no way different from the back), place the paper in the palm of the hand, when it will be found that the heat will cause the paper to curl with its film side inward. Having adjusted the back of the printing frame, the next point is the exposure. This can be only learnt by experience, and in order to simplify matters I would recommend the worker to always use the same paper, same light and expose at the same distance, and use the same developer. With very little experience and attending to these details, the operator will soon turn out first class bromides with the regularity of silver printing. Having made a trial exposure off a good average negative, the next point is developing. There are many developers for this class of work, and I therefore set forth the uses and merits of each. First comes the ferrous oxalate, which by some workers is considered the best, owing to its being the oldest developer for bromides.

No. 1.

Sulphate of iron	2½ oz.
Warm water to	10 "
Sulphuric	15 drops.

No. 2.

Neutral oxalate of potash	10 oz.
Warm water to	40 "
Potassium bromide	20 gr.

For use add 1 part No. 1 to 4 parts No. 2, not vice versa on any account. Use a special dish for this developer. Place the paper, after exposure, in a clean dish, and pour on developer. Image will soon make its appearance, and is complete when image appears fully out. After development, without washing, immerse the print for about two minutes in the following clearing solution, pouring off and repeating:

Water	80 oz.
Glacial acetic acid	½ "

Prints must then be thoroughly washed for 10 minutes to get rid of acid, and are then fixed for 15 minutes in

Water	80 oz.
Hypo	1 lb. (avd.)

and then washed for one hour in running water, and hung up to dry naturally. The color given by ferrous oxalate is a good black. Special care must be taken, however, in using it.

The next developer is metol, which is a great favorite owing to its cleanliness, which is the reverse in using ferrous oxalate, and the one I use myself is:

No. 1.

Metol	50 gr.
Soda sulphite	1 oz.
Potassium bromide	6 gr.
Water	10 oz.

No. 2.

Potassium carbonate	1 oz.
Water	10 "

For use, 3 parts No. 1 to 1 part No. 2. With this developer, and all the following, no clearing is needed, the prints being merely well washed in water and fixed.

Metol gives a good gray-black, the image appearing at once, and can be used a number of times. For those who like a blacker print, with more contrast, the following is excellent, and, being only one solution, is convenient where a lot of work is to be done:

Metol	50 gr.
Hydroquinone	25 "
Soda sulphite	1 oz.
Soda carbonate (crystals)	½ "
Potassium bromide	30 gr.
Water up to	40 oz.

This keeps well, and the chemicals must be dissolved in the above order.

Hydroquinone is used by some for bromides, but is apt to give a greenish, unpleasant tone, and is not to be recommended.

For use, for those who would like a formula, I give the following, however:

No. 1.

Hydroquinone	80 gr.
Soda sulphite	1 oz.
Potassium bromide	15 gr.
Water	10 oz.

No. 2.

Caustic soda	80 gr.
Water	10 oz.

Use equal parts with an equal amount of water. Amidol is now used largely for bromides, and gives a gray-black color like metol. Its disadvantage is that it will not keep in solution.

Sulphite of soda	1 oz.
Water	20 "

To each ounce of the above add 2 or 3 grains of dry amidol.

Another excellent developer is rodinal, which gives beautiful, soft, gray tones; moreover, it is cheap, only one solution, and economical:

Rodinal	1 part.
Water	20 to 30 parts.

Beautiful blacks can be got by the addition of a few drops of the above hydroquinone No. 1 solution to each ounce of developer.

A very effective color for bromides is obtained by the use of alum and hypo.

Hypo	10 oz.
Ground alum	1 "
Boiling water	70 "

Dissolve the hypo in the water first, then add alum slowly. The solution should be milk-white. Do not filter the solution.

The print should be previously alumed and then placed in this bath heated to 110° Fah. In about three-quarters of an hour the black color of the bromide will be toned to a beautiful sepia color, which is very effective for prints of old cottages and houses. One of the great advantages of the bromide process is the ease with which clouds can be produced on the print, provided they exist in the negative. All that is necessary when developing is to stop when the image is fully out, wash, and then go on developing the sky by means of a brush dipped in the developer. Certain parts of a picture can by this means be developed up which would not otherwise appear. I am sure that those who take up bromide printing are bound to succeed if they take a little trouble, and, if they will do this, their efforts will be amply rewarded.—The Photographic News.

A Frankfort (Germany) man has patented what he calls a "dry barrel," for containing vegetables or other substances preservable by being kept in an atmosphere entirely robbed of its moisture. The idea is, however, by no means a new one, and it consists of putting into every-day use a device long in use in chemical laboratories—drying by the use of hygroscopic agents; in this case, by the use of caustic soda. The apparatus is simply a box with a false bottom placed several inches above the real bottom, with a metallic tray, carrying sticks of caustic potash placed between. The vegetables, fruits, etc., are placed on the false bottom, which consists of slats, allowing a free circulation of air between the two parts of the box. The air comes in through the bottom, and is robbed of its moisture by passage over the potash. A French inventor proposed a similar arrangement some time ago, using sulphuric acid as a drier. The potash need be renewed only every six months, says the inventor.

THE YARROW-SCHLICK-TWEEDY SYSTEM OF BALANCING ENGINES.

WE publish an illustration of the quadruple expansion engine showing the system of balancing perfected by Mr. Otto Schlick, Mr. A. F. Yarrow and Mr. John Tweedy, of Messrs. Wigham Richardson & Company, and now being extensively adopted by the best known firms. The system may be said to have been evolved out of the quadruple expansion engine, in the development of which Mr. Tweedy and Mr. Walter Brock, of Messrs. Denny's firm, have been closely associated for a number of years. But while Messrs. Denny adopted in the early days the two-crank tandem type, Messrs. Wigham Richardson & Company have always fitted the four-crank arrangement, and during the last ten years they have constructed quite a number of such engines, working at pressures varying from 180 pounds to 215 pounds per square inch; fifteen sets have been built by them during the last three years.

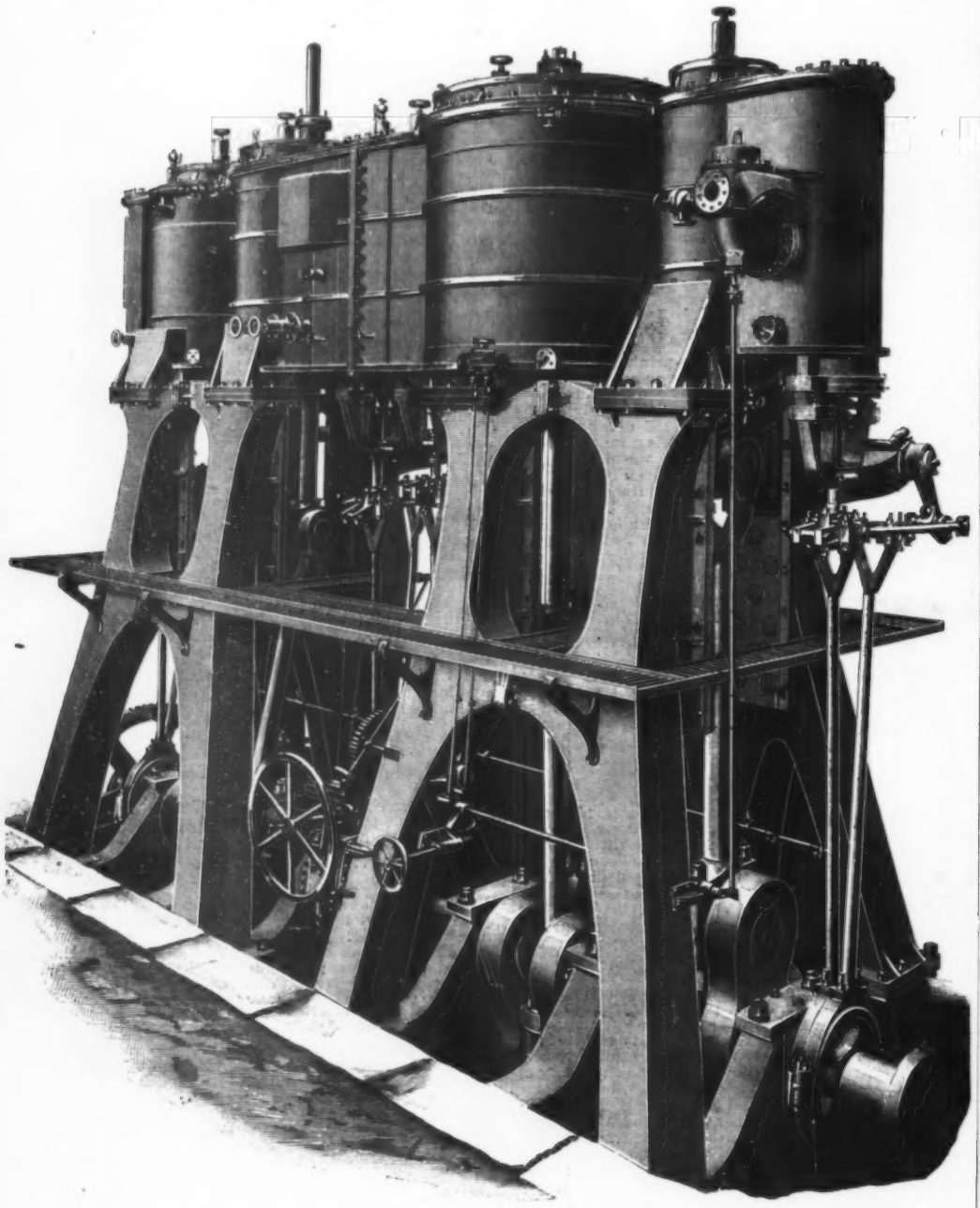
We illustrate a set of the latest engines of the class. The cylinders are 24 inches, 34 inches, 57 inches and 74 inches in diameter respectively, and the stroke is 54 inches, the working pressure being 210 pounds per square inch. The high pressure cylinder is placed forward, and the mean pressure cylinder aft of the second mean pressure and low pressure cylinders. These two cylinders are bolted firmly together, allowance being made for expansion in the machining of the castings. The outer cylinders, being small in diameter, with very little overhang for the steam chest, are quite separate from the remaining cylinders—they are not attached to them in any way—being supported only by the columns, which, as will be seen from the illustration, are spread forward and aft to give a stable bearing. In practice it has been found that the cylinders so arranged are perfectly rigid and satisfactory, while disturbance due to expansion is entirely avoided. To prevent vertical distortion through change of temperature, and at the same time to avoid the use of a long condenser, which, even in three-crank engines of any size, is often found objectionable, the back columns do not form part of the condenser, but are carried right down to the bedplate. A short condenser is placed either immediately below the exhaust orifice of the low pressure cylinder, as in the present case, or when sufficient floor space is not available at the side of the ship, under the deck, in cases. It will be seen that the front supports consist of four standards bolted together in pairs, these standards being suitably shaped to receive the crosshead guides. The wide arch formed by the lower parts of each pair of standards gives good access to the engines. In the engines illustrated there are four Y columns at the back, tied also at their upper ends; but in subsequent engines built by Messrs. Wigham Richardson & Company, the back columns have been made exactly the same as the front columns. The crankshaft is supported on six bearings fitted into a substantial bedplate in the usual way. The pumps and other details are also arranged much as in the ordinary engines.

In regard to the economy in fuel, we are able to state, after the perusal of private documents prepared by the owners of certain ships fitted with Messrs. Wigham Richardson & Company's quadruple expansion engines at 215 pounds pressure, that the saving in fuel is 10 per cent., as compared with triple expansion engines of the same power working at 180 pounds pressure and fitted in sister ships.

But perhaps the most interesting feature of the engines we have been describing is the successful way the system of balancing, now so widely known, has been worked out by Mr. Tweedy. It can be shown that both as regards balancing and the reduction of loss through friction of bearings, the measure of success depends upon the closeness to each other of the fore and aft centers of the cranks opposite or nearly opposite, and further that the heavier weights should be on the two inside cranks

In the quadruple expansion engines the power developed by each of the four engines is approximately equal, whereas in the four-crank triple expansion engine, for reasons into which we need not enter here, the power developed by each of the low pressure cylinders is less than that obtained from the intermediate and high pressure cylinders, and the parts are proportionately smaller. In the quadruple expansion engines the required heavier center weight is obtained by the heavier first intermediate and low pressure pistons, while in the other case it is obtained by the lighter working parts of the low pressure engines.

Taking into account the freedom from disturbing forces, the good turning qualities, the simplicity of the arrangement and the accessibility of the parts, and the success of the ships already fitted, there is every prospect that the practice of the immediate future will run more or less on the lines of the types of engines we have illustrated.—Engineering.



QUADRUPLE EXPANSION ENGINES ON THE YARROW-SCHLICK TWEEDY SYSTEM.

OBSTACLES TO COMMERCE.

SOME months ago the Kreuz Zeitung, one of the organs of the Agrarian party in Germany, solemnly asserted that numerous cases of severe colic had been traced to eating American sliced apples that had been dried on zinc in order to give them finer color and preserve them better. Last spring the markets of Berlin and other large German cities were full of delicious apples, large, fragrant, fine-flavored and cheap, that came from the United States. They were undoubtedly superior to the European fruit, but no newspaper dared say so, and some of the journals were really dubious as to the wisdom of importing our apples. "Might they not," it was suggested, "bring in some beetle or moth, whose worm would play havoc with the German apples?" Then there is the bugaboo of American meat. Can it be eaten by Europeans without imperiling their lives? "Is it not well known," asked an excited Agrarian organ a year ago, "that a horse slaughterer of Long Island City for years worked up 6,000 diseased horses yearly into corned beef and forwarded the mess to Antwerp to be scattered over Western Europe?" Alleged experts in the pay of the German Agrarians, who are bitterly opposed to the importation of food products from the United States, have long been casting doubt on the thoroughness of meat inspection in the United States; and recently a Belfast newspaper has been appalled at the evidence it has discovered that American millers are adulterating the flour they send to Ireland, by mixing finely ground corn meal, having the general appearance of wheat flour, with their wheat.

These incidents illustrate one phase of the obstacles with which every successful exporting country has to contend. Trade rivals will slander their goods and try to impeach their honesty. Sometimes the trade in one or another article is seriously damaged for a while by this hostile depreciation and misrepresentation, but in the long run a worthy article usually makes its way against this sort of injustice. There is little or no patriotism in trade, and when German merchants, for instance, think they can buy a better article at a smaller price in a foreign land, they will buy it and ignore the home product. The story of our refined petroleum in Germany is an excellent illustration of this fact. Everything short of actual prohibition has been done to keep our kerosene out of the German market, so that the Russian article may have full sway. These efforts have thus far failed, both because the Russian oil is really inferior and also because, as yet, it has never been delivered in Hamburg as cheaply as the American oil.

Many illustrations might be given of the various obstacles that obstruct the development of trade. It is a mere truism to say that trade and industry are paralyzed wherever the means of transportation are lacking or inferior, but how curiously is this fact often illustrated. All along the river lands of eastern Nicaragua there are large areas perfectly adapted for the cultivation of the banana, but there is only one district on that long stretch of seaboard from which bananas may be profitably exported. This is the region of the Bluefields River, the only stream that can be entered by steamers large enough for the fruit trade. All the other rivers are closed by sandbars at their mouths, and the rich banana lands are almost worthless in consequence. China is supplied to a wonderful extent with navigable rivers and a great network of canals connecting them, but the extreme slowness of these means of communication is sometimes very detrimental In some of the provinces, two years ago, tens of thousands starved to death before relief could reach them from other provinces where there was an abundance of food.

We little dreamed when Congress was discussing the Dingley bill of the painful excitement this measure was producing in the little island of Sicily. Thousands of people there live by raising oranges and lemons. Half the annual crop had been purchased by the United States, and it was proposed to increase the duty from 25 to 70 cents a box. Mass meetings were held at Palermo, Messina and Catania, and all classes attended, from the wealthy landowners and bankers to working men and women. The people feared their chief industry would be ruined, and for some weeks, in these numerous meetings, they discussed how to get other markets and how to diversify their industries.

A year before these poor people had suffered terribly from their disregard of the laws of demand and supply. In three months they shipped nearly 800,000 boxes of fruit to this country; the influx glutted our already well-supplied markets and much of the Sicilian fruit barely realized freight charges and duties. Nearly every nation except Great Britain has a protectionist policy, and as far as these duties tend to restrict the purchase of goods from other lands, they are of course an obstacle to international trade; but the Germans are telling us now that they don't care half so much about our protectionist policy as they do for our ever changing customs rates. They say that no sooner do they adapt themselves to one tariff schedule than we put another in force, and they find this very embarrassing. Some countries entirely block trade in some directions by prohibiting all imports in certain lines. Thus the Venezuelan tariff provides that no article may be imported into that country if it can advantageously be produced at home. Under this rule no foreign sugar is allowed to enter Venezuela. German lead pencils are not permitted to be used in the schools and public and railroad offices of France; foreign sugar cannot be taken into Cochin China, and scores of similar instances might be mentioned. Laws practically establishing export monopolies are also in force, as in the Congo Free State, where such high export duties have been placed upon the export of ivory and rubber that the entire business is now coming into the hands of the Congo State government, which is reaping all the profits. We cannot deal with Spain so advantageously as England. France and Germany can, because we have no favorable trade treaty with her, while their commercial treaties with Spain give them special advantages. With a high discriminating tariff against us, Spain does not offer an inviting field to our business enterprises.

The evils of overproduction have been illustrated above in the case of Sicily. Not a few countries, large and small, have suffered terribly from this misfortune in recent years. The world at large scarcely realizes

yet the calamity that has befallen widely scattered regions on account of the enormous decline in the price of oil of cocoanut. Twenty years ago this oil began to be more largely employed in the manufacture of soaps, and copra, the dried cocoanut meat from which the oil is made, commanded most remunerative prices in Europe. The result was to stimulate the planting of tens of thousands of acres in the Pacific Islands, Africa, Asia and tropical America. The new groves are now in full bearing, the world is not consuming the entire amount of copra they offer, the price has fallen from $115 to $52 a ton, and many planters have been ruined.

The coffee markets of the whole world have been warning the coffee producing countries for some years that a crisis would be sure to come unless the volume of product were curtailed. The warning has not been heeded. The production of Brazil in 1896–97 was 9,000,000 bags, and crops of Venezuela, Colombia and Central America were in proportion. There is distress today among the coffee growers, and a very serious crisis is threatened, unless production is curtailed. Overproduction is one of the commercial evils which it seems impossible to combat until the cure is wrought by the misery it brings. Manufacturers, from America to Russia, reaped no benefit from the excessively low price of raw cotton in 1894, brought about by the vast production of the United States, Egypt and other countries. It led to throwing on the market vast quantities of goods that could not be consumed, and hundreds of thousands of operatives have been made to bear the brunt of the consequent distress.

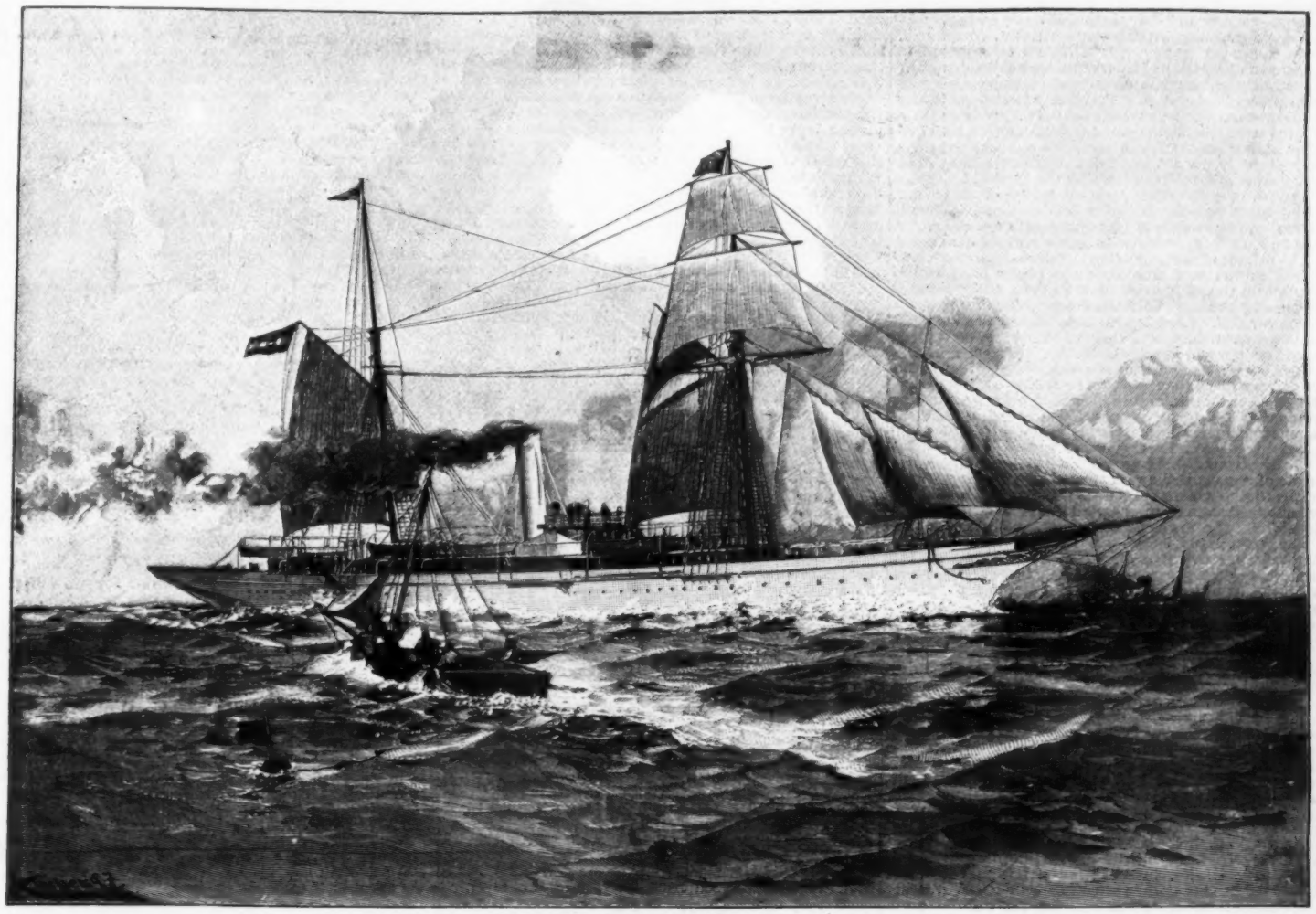
whence they descend to the little ports on the Pacific. Another obstacle to commercial progress that the world is beginning to feel is the wicked and wasteful methods by which some sources of wealth are being destroyed. All along the west coast of Africa, where rubber was once collected almost at the ocean's edge, it is now necessary to go forty or fifty miles into the interior to get a pound of rubber. The natives always destroy the plant to get the rubber, and until recently no steps have been taken to stop this wholly needless waste.

The same ruthless methods have been employed in Central America, until some of the states, frightened by the impending annihilation of a valuable industry, have forbidden the gathering of rubber for fixed periods to give the sources of supply a chance to recuperate. It is only five years since the rubber trade of south Madagascar began. In 1893 the export of rubber was 1,800 tons, and three years later it had dropped to 168 tons. The gatherers had simply wiped the plant out of existence, until they had to travel five and six days northward to get any rubber. The same reckless methods were introduced into the Congo Free State until the authorities foresaw the certain destruction of one of the greatest resources of the country unless the waste was stopped. Throughout that vast region it has now been made a crime to destroy the rubber vine. The natives are being taught that they may tap the vine, the juice will flow for them, the wound will heal and the vine will produce again. The Indian collectors in Brazil have shown much greater sense, for they

BARON NATHANIEL v. ROTHSCHILD'S STEAM YACHT "VEGLIA."

BARON NATHANIEL v. ROTHSCHILD'S new yacht "Veglia," which was built by his order in the ship yards of Henderson, in Glasgow, is not only the largest yacht in existence, but is undisputably one of the most beautiful and artistic in all its details. This floating palace is 254 feet 6 inches long, 32 feet 5 inches wide, the draught is 14 feet 9 inches and the displacement 1,000 tons. The crew, including the officers, consists of 52 men. The commander is Capt. Ströll, who was formerly an officer of the Austrian Lloyds. In arranging the interior of the yacht the instructions of the owner were closely followed. The large saloon is unusually high and is paneled with mahogany; beautiful tapestry, rich carpets, bookcases, a great table with fine books and maritime papers, two desks, a Bösendorfer piano, upholstered and unupholstered easy chairs of various styles, a beautiful fireplace with an alabaster clock, and valuable colored engravings on the walls, make the room very attractive. The saloon is lighted in the evening by twelve incandescent lights in crystal globes. A wide open staircase leads to the recreation room, which is above the saloon. This is also paneled and is decorated by an old painting from the London Museum, "The Battle of Trafalgar." Next this is the baron's workroom, with a multiplicity of objects tastefully arranged.

The owner's sleeping room is amidships, where the motion of the vessel is least perceptible, and the bath-



BARON NATHANIEL v. ROTHSCHILD'S STEAM YACHT "VEGLIA."

There are countries where the obstacles to trade uplifted by the governing powers are almost insuperable. See Tibet, with many of its valleys thickly populated with tribes, rich in herds of cattle and horses, with wool, hides, furs, gold dust, mercury and other products that find an outlet only into China. These valleys are locked against all other nations. The thousands of Lamas, priests of the Buddhist faith, have political reasons for excluding all foreigners, but more than they, it is the Chinese who maintain the wall around Tibet. Though the country is only partly tributary to China, she forces the Tibetans jealously to guard their frontiers. China believes it is to her own trade interests to exclude from Tibet the foreigners she cannot eject from China proper, and the Pekin authorities do all they can to raise bad blood between the Tibetans and Europeans. It is Mussulman hatred that still practically excludes the western nations from Morocco, one of the richest and most fertile parts of Africa and at the very doors of Europe.

Walls built only in small part by human hands keep such countries as Bolivia from sharing in the general blessings of trade. Even before Bolivia lost the small frontage on the sea, wrested from her by the fortunes of war, she gained the outside world only by the most strenuous efforts. She is shut in by the Cordilleras on the west, by the Brazilian desert on the east, by the wastes of Gran Chaco never traversed save by the hardiest explorers on the south, and her rivers flowing north to the Amazon are not navigable. Nothing but railroads can relieve her complete isolation. All her products that leave the country are lifted on the backs of mules through passes rising 15,000 feet above the sea, make small incisions that do not destroy the plant and it yields a supply of rubber every year.

Scanty population is another great obstacle to business development; and it is one which seriously retards some of the South American states. Paraguay supplies a striking illustration of this fact. There is no finer timber in the world than the Paraguayan forests afford, but as yet there is neither sufficient capital nor labor to handle it for the markets it might easily reach. Some years ago the Great Southern Railroad of Argentina wanted a very large quantity of hard wood railroad ties within a given time. There were the Paraguyan forests, easily within reach of the largest steamers from Buenos Ayres. The lasting qualities of this timber, either in earth or water, had been proved over and over again. But there were no facilities in Paraguay for filling the large contract within the required time, and with inexhaustible supplies near at hand, the railroad company found it necessary to cable to Australia for railroad ties, and it received many shiploads from that distant part of the world. The other day an Italian company took a contract to bring 1,000 Italian families to Venezuela every year for a series of years. The country is at a standstill for lack of population. The llanos where millions of cattle might graze, the wide, rich valleys of the north, are not yielding a tithe of their ample resources for lack of people to make them available. Railroad capitalists will not build the needed lines because, they say, the population is too sparse to insure a profit. If Venezuela can only fix immigration on her healthy uplands, a new and brighter era will dawn on the republic.—Cyrus C. Adams, in The New York Sun.

room is connected with it. A number of other well arranged cabins are provided for the guests. The woodwork of the dining room is made of light American wood, and in the center of this room is a dome from which hangs a beautiful electric chandelier. A large extension table provides places for 22 persons. On the deck is the smoking room, which is paneled with mahogany and contains a costly picture of the English war vessel "The Royal George" of 1782.

In regard to the machinery, there are, besides the main engines, which indicate 2,000 horse power, and give the vessel a speed of 15 knots an hour, 23 independent steam engines on board, eight steam pumps, and two dynamos of 250 ampères 65 volts, and 35 accumulators. There are 200 incandescent lamps of 16, 32, 50 and 300 candle power and the yacht is also provided with a large search light. There are also electric ventilators. One sight well worth seeing is the mechanical laboratory, with all the proper apparatus. The photographic apparatus and the dark room are not wanting, for Baron v. Rothschild is a most enthusiastic amateur photographer.—Illustrirte Zeitung.

A London Daily News correspondent says there have been some extraordinary discoveries of bullets in wounded men in Sir William Lockhart's campaign by Surg. Maj. Beaver, of the Coldstream Guards, who has a Roentgen ray apparatus. At Karappa he showed the correspondent photographs of cases which had puzzled the doctors, and which had led to a good deal of ineffectual probing for bullets. His apparatus had instantaneously discovered where they lay.

PAINTS AND THEIR VAGARIES.

EVERY paint user knows that for a painted surface to be successfully accomplished, great care and attention have to be exercised in the selection of one of the materials used. It is pretty generally acknowledged that when a man has failed at any other trade he can wield the brush as a painter. This wielding of the brush is a very simple matter of manual labor only—one which requires but little skill, and capable of being performed by anyone of average ability. But it is not everybody who wields a brush that can or does understand the nature and vagaries of the paint he is using. The conditions of use are so diverse that it is only the skilled craftsman—the man who has been a painter by trade all his life—who can give a rational explanation of any defects in a painted surface. What causes blisters in paint? What causes the colors to sink in? What causes paint to remain soft underneath while the exterior surface is bone-dry and fairly hard? What, in fact, causes any and all of the "deviltree" a painted surface exhibits six months after the paint has been laid on? The jobbing hand, the nondescript sort of fellow, who has tried every trade and failed at all, cannot tell his employer why the paint he has laid on exhibits the above mentioned or any other defect. It is only the "old hand," the skilled workman, who can offer an explanation. But even with him the explanation offered is not always the correct one. It requires the aid of the chemist as well as the craftsman to interpret all the reactive changes that a coat of paint undergoes. It is the writer's purpose, therefore, to explain the nature, qualities, reactive changes that occur in the paint pot and the coat of paint laid on the surface of any material. In the present paper the question of the sinking in of colors will be considered. Before doing so, however, it will be best to explain the actual composition of this compound called "paint."

Essentially a paint is composed of linseed oil, pigment, driers and turps. The oil used is generally boiled oil—that is, the raw linseed oil has been subjected to a particular treatment whereby it loses its raw or native qualities and becomes converted into a different body in many of its characteristics. The boiling process consists in heating the raw oil to a temperature of over 500° Fah., whereby a lot of water that is inherently present in the oil is expelled. The oil is then either oxidized by passing steam or air through it or it is boiled with some sort of a mineral such as litharge (an oxide of lead), borate of manganese, calcium, sulphate of zinc, or some other body which will react on the fatty acids of the oil to oxidize them and thereby change the fluid from a limpid oil to a viscous varnish. (To illustrate the difference between an oil and varnish, drop a drop of each fluid on a piece of glass or porcelain, and note the difference in the drying power: the oil, if in the raw state, will remain fluid a very long time before it shows any signs of drying or hardening, and then it is only on its exterior surface that the drying occurs, forming a skin thereon; whereas with the spot of varnish, that begins to dry and harden immediately it is exposed to the air.) Now, the object of boiling the oil has been to render the oil of a more drying nature—raw oil takes three months to dry when exposed to the air, but boiled oil does not take as many weeks. The pigment of a paint consists of a dry powder color which imparts the tint to the paint; this is ground up in the oil vehicle, whereby each dry particle of paint becomes coated with a layer of drying oil, whence such mixtures, when spread out thinly on a surface, will dry to form a thin layer or coat of paint. If the mixture of pigment and oil is not sufficiently siccative, the painter mixes in some "driers," which enables the compound to dry at a quicker rate. The addition of turpentine to a paint is made so as to render the paint of a thinner or more fluid consistence, whereby the paint can be easily spread by means of a brush. These details are of necessity known to most painters; but this explanation is needed here, so as to render perfectly comprehensible what is to follow.

Now apart from the chemical nature of the pigment used—whether it be a sulphide, oxide, chromate, silicate, carbonate, etc., of a metal—it will be noted, from the above, that the nature of the "driers" mixed with the paint has also to be reckoned with, and, lastly, the mixture of the turpentine. Consequently a "pot of paint," or "coat" of ditto, is not a simple compound. Quite the opposite, in fact: for although the oil of turpentine used is always of the same nature, putting out of consideration for the moment the idea of adulteration or substitutes, the chemical composition of the pigment is not always the same; neither is the drier always the same. We shall have occasion to consider these points in other articles. At present we will confine our attention to the loss of brightness, or "sinking in," as it is called, of colors.

Let us consider the nature of a coat of paint. It consists of pigment, an oil varnish (i. e., the boiled oil), drier and turps. When this layer is exposed to the air (that is, when the painter has ceased spreading it with his brush) the oil vehicle begins to become decomposed, whereby it is separated with its components, oleic, palmate, etc., acids, and at the same time the base of glycerine, to which these components are attached in the undecomposed oil is eliminated. As these chemical changes occur, the atmospheric oxygen seizes on the olein, and converts into linolein, which is a solid, tough, elastic, transparent body. The other fatty parts of the oil are more or less absorbed by the pigments, or else they are pushed to the surface of the coat of paint (as will be explained infra). The glycerine, however, does not become absorbed.

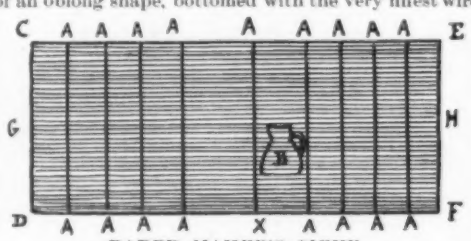
As the exterior surface of the coat of paint becomes oxidized, as above explained, the particles of solid linolein sink to the undermost parts of the coat of paint, and thus a fresh layer of the oil vehicle is pushed up to the exterior surface of the coat of paint, to be similarly converted by the atmospheric oxygen into solid linolein. When all the oil has become thus converted, we can conceive that, as each particle of solid linolein sank, the particle of pigment was left denuded of a pellicle or covering of oil. Also, we can conceive that the interstices between the particles of solid linolein and those of the pigment become filled with air, and also with the glycerine that has been eliminated from the oil by the decomposition it has undergone.

Now, glycerine is a greedy absorber of moisture, and, as a consequence, side by side with the transparent shining particles of solid linolein there are particles of water or moisture. We can now conceive the coat of paint to be in this condition. First, there is most of the oil next to the surface on which the paint is laid; above this we can conceive its pigmentary particles almost uncovered with oil, and side by side, or permeating the mass, is a quantity of aqueous particles. Now, the color of the pigment is, of course, dull or bereft of sparkling brilliancy, and it is the object, or should be, of the oil vehicles to clothe each particle of pigment with a layer of shining oil. This, however, is not the case for the conception above foreshadowed. Now, when all the oil has become converted into solid transparent linolein, this linolein will rise to the surface if it has not become too hard and solid (that is, if it has been quickly formed); but as it rises above the pigment particles they sink, and, becoming mixed with the glycerine and the water it has imbibed, we have a layer of transparent linolein above a layer of pigment, glycerine and water. Now, the oxidation of this linolein still proceeds, and will proceed until it is of a uniform tough skin. To enable it to do so its absorption of oxygen proceeds, and as this oxygen unites the layer of glycerine and water that is imprisoned by the superimposed skin of linolein, the glycerine becomes oxidized to a glyceride, and which more or less permeates the skin of linolein, and thereby causes the latter to lose its transparency and become opaque; consequently, the surface of the coat of paint is bereft of brilliance, and exhibits a dull appearance.

It will naturally occur to the thoughtful reader that what is wanted to prevent this sinking in of the pigment is either the incorporation of some solid transparent body that will not allow the solid pigment to sink through the oil, or else some process or material that will quickly convert the oil vehicle into solid transparent linolein, for if the oil be converted into this substance before the pigment has had time to settle away from it, the linolein as it dries will inclose the particles of pigment in it, and slowly form a transparent layer of linolein round each particle of pigment (the glycerine that has been eliminated would in this case be driven beneath the pigment and linolein, with what effect we shall see in a future article). Now, if a resin be incorporated with the oil, or a varnish be used as the binding vehicle for grinding up the pigment in, then the colors will not sink in; because, side by side with each particle of solid opaque pigment there would be a particle of solid transparent resin which would reflect the light, and consequently cause the coat of paint to exhibit a brilliant appearance. Paint grinders, therefore, should grind up their pigment in an oleo-resinous vehicle. There is an additional reason why such a vehicle should be used, because a resin will absorb glycerine, and thus, instead of fluid glycerine and water being beneath a coat of paint, which is often the cause of blistering and peeling off of paint, the coat of paint would be one solid, homogeneous mass from exterior to the undermost surface.—H. Standage, in The Building News.

THE SIZE AND WATER MARKS ON PAPER.

THE mould used by paper makers is a kind of sieve of an oblong shape, bottomed with the very finest wire



PAPER MAKER'S SIEVE.

strands, all of which run horizontally from end to end. From top to bottom and about an inch apart are placed "chain wires," and on the right hand side of the mould the wire water mark, which, together with the wire marks, appears semitransparent. The reason of this is that both water mark and wires are slightly raised, and, of course, the pulp is thinner there than anywhere else. Any ordinary sheet of paper held up to the light will show this, and serve to extra illustrate the diagram above.

Here C D E F is the mould which the workman drops into a vat of pulp; the fine strands, which run from G to H all the way down the mould, A A, etc., are the chain wires, and B is the water mark, in this case a jug. The water in the pulp, of course, runs through the sieve, leaving a layer of soft matter, which, after a while, hardens into a sheet of paper. The water mark was at one time the trade mark of the maker, but subsequently became merely a symbol denoting the size of the sheet of paper before it was folded. The smallest sheet was water marked with a jug, as above, and termed "pot;" the next had a cap and bells, hence our term "foolscap;" the next a horn, hence "post;" others had a "crown," and so on. At the present day all water marks have once more become trade symbols, and cannot be depended upon to afford any evidence of size. But at one time, i. e., before the year 1750, this was not so, and, therefore, these water marks, irrespective of their antiquarian value, serve a useful purpose, namely, to point out in cases of doubt whether any given book is an octavo, quarto or folio or a variation of any of these sizes.

To refer once more to the diagram: Take a sheet of paper, supposed to have come from the mould, and double it in half at the line, A X. The water mark will, in that event, appear in the center of the half sheet, and the folded paper is of folio size. Now fold the paper the contrary way and the water mark will appear at the bottom, but cut in half; the paper thus folded is quarto (4to). Now fold it the contrary way again and a section of the water mark will appear at the top; the paper thus folded is octavo (8vo). We can go on folding, and in every subsequent case the water mark will appear at the edges, while, as the paper gets smaller and smaller, the sizes are styled 12mo, 16mo, 32mo, and so forth.

In the example given, a book made of the sheet of paper in question would be a pot folio, pot 4to, pot 8vo, and so on; but as larger sized papers were used, another book might be a post 8vo or a crown 4to, etc., according to circumstances.

As stated, this is one way of finding out the size of an old book; but there is another way—by means of the "signatures," which consist of small letters or figures at the foot of the page of nearly every book. The leaves (not pages) must be counted between signature and signature, and then, if there are two leaves, the book is a folio; if four, a 4to; if eight, an 8vo; if twelve, 12mo; if sixteen, 16mo; and if thirty-two, a 32mo. Take, as an example, this very book you hold in your hand, and it will be found that there are eight leaves between signature and signature; hence it is an 8vo, though a small one, owing, of course, to the small size of the paper from which it has been made, viz., crown. Had it been a little smaller (still preserving its oblong shape), it would have been a foolscap 8vo; if somewhat larger, a demy 8vo; if larger still, a royal 8vo; and largest of all, imperial 8vo. The quartos and folios are governed by identical rules, and hence, in the trade, the sizes of books are very numerous.

Simple as this method of computation may appear, a great deal of controversy has taken place on the subject, so much so, indeed, that there are people to be found who stoutly maintain and adduce proof to show that what looks like a 4to is in reality an 8vo or vice versa.

It would be out of place to enter into a discussion of this nature, and, therefore, I should advise the young collector to count the leaves between signature and signature and to abide by the result, regardless of all the learned arguments of specialists. If there are no signatures and the book is an old one, then study the position of the water mark.

Paper makers at one period made their sheets in frames of a given size, so that it was a comparatively easy matter to distinguish the size of a book at a glance. Nowadays, however, there appears to be but little uniformity in this respect, and the difficulty is, consequently, considerably increased. The following measurements will, however, be found approximately correct, and they may be utilized in a practical manner by taking a sheet of brown paper of the required size and folding it as previously mentioned, thus forming crown 8vos, crown 4tos, elephant folios, etc., at will. The practice is good and it will not need to be often repeated:

A sheet of	foolscap	measures	about	17	in.	by	13 in.
" "	post	"	"	19	"	"	15 "
" "	crown	"	"	20	"	"	15 "
" "	demy	"	"	22	"	"	17 "
" "	royal	"	"	24	"	"	19 "
" "	imperial	"	"	30	"	"	22 "
" "	elephant	"	"	20	"	"	23 "
" "	atlas	"	"	34	"	"	26 "

The only paper used as a general rule for making up into 8vo books is foolscap, post, crown, demy, royal and imperial; 4to books are made up of all the sizes, though elephant and atlas are chiefly devoted to folios.—From Book Collecting, by J. H. Slater.

A NEW BASIS FOR PHOTO-MECHANICAL PROCESSES.

By R. ED. LIESEGANG.

IF a print is prepared on gelatine bromide of silver in the usual way, that is, the paper exposed under a negative, developed with hydroquinone, fixed and well washed, and if the finished print be painted with a concentrated aqueous solution of ammonium persulphate, the image will be bleached in about a quarter of an hour. If the solution then be superficially rinsed off with cold water, and then rubbed with the warm hand, those parts of the print which were previously black will dissolve. The whites—that is the unexposed portions—will remain unchanged. A gelatine relief will be thus obtained. In the very darkest parts the paper will be laid quite bare. In the half tones about half the gelatine will be left, and in the light the gelatine will stand up in high relief.

The relief—if the gelatino bromide of silver was not too thin—will be, in the wet state, about as high as a still damp carbon print. When dry the relief can still be seen. It can be made more distinct if the gelatine be colored with some dye, such as an aqueous solution of methyl violet. There is thus formed a complete negative, for the thicker parts of the relief take up more dye than the thin. This method of producing a relief ought to be of use in various photo-mechanical processes.

With negatives on glass the same process is possible, but the relief which is obtained on an ordinary rapid commercial plate is never so distinct as with the less sensitive bromide paper. For this reason I chose bromide paper for my experiments, and I recommend it to those who wish to experiment.

The negative which is to be used for the relief must not be developed with pyrogallol. I have already pointed out that an oxidation product of pyrogallol may be very closely combined with the metallic silver of the image, and this makes it more difficult to dissolve. This toning action would naturally be a disadvantage in the later treatment. The development must, therefore, be effected with a developer which does not stain, such as hydroquinone or paramido-phenol. The negative ought not also to be intensified with mercury, as this also produces a strong tanning action.

A negative bleached with the persulphate of ammonia may be treated exactly as a carbon print, namely, with lukewarm water, and then may be converted into a positive. If the plate has not been too long developed or exposed, pigment transparencies are obtained which may be used as lantern slides and transparencies. The same result may be obtained on gelatino-chloride printing-out paper, and it is immaterial whether the image has been toned out or not. The use of the alum bath is also not prejudicial, although the presence of alum in the same may have tanned the gelatine.

With all these papers it has been proved that the metallic silver in the half tones only lies on the surface of the film, and only in the darkest parts does it go down as far as the paper or glass. With gelatino-chloride papers, the paper is laid bare only in the deep-

est shadows. The process is a confirmation of my theory of the structure of the negative which had hitherto only rested on microscopic examination and scraping.

In searching for the causes of these phenomena, it was apparent that the ammonium or potassium persulphate not only bleaches the metallic silver, but that the saturated solutions also possess considerable solvent power for metallic silver.*

The formation of the relief may either be due to the fact that the places free from silver have been tanned more than they originally were or that the solubility of the places containing silver has been increased—I have determined that the latter is the case. The half of a gelatino-chloride print was painted with ammonium persulphate. When rubbed with lukewarm water the image on the unpainted half adhered perfectly; on the painted side, on the other hand, the image parts dissolved, while those parts free from silver did not. Those places of the gelatine film in which metallic silver was embedded were thus by treatment with persulphate salts rendered more soluble than those parts containing no silver.

There are only two possibilities (1) that the gelatine before the experiment was so altered on the exposed parts that the persulphate salts acted differently on it to what they do on ordinary gelatine, or (2) that the whole of the change of the gelatine is a result of the action of the persulphate on the metallic silver embedded in it. The first possibility ought not to be quite excluded, because many photo-chemists assume that the gelatine in the exposed parts takes up bromine, as it plays the part of a sensitizer.

I believe that the question could be determined, and I converted half of a finished gelatine chloride print with silver bromide by means of cupric bromide, and then removed the silver bromide with hyposulphite of soda. After treatment of the whole image with ammonium persulphate, there was formed, by rubbing with lukewarm water on these places without silver, a reversed relief; the previously black parts remained and the lights dissolved. This was also the case with a bromide print. There might be ascribed to the copper salt a tanning action for those places containing silver; then, on the other hand, a mixture of a copper salt and persulphate of ammonia should act weaker than the latter alone. Actually, this was not the case. It ought to be assumed that solution of the gelatine in those places where there was silver is, therefore, a secondary action of the reaction of the persulphates on metallic silver. A further proof of the dependence of the change of the gelatine on the bleaching of the silver is given by the fact that with too short an action of the persulphate, the still black and deepest shadows did not dissolve in warm water, while the half tones did.

As regards the use of this method for photo-mechanical work, it must be remembered that the relief is reversed, as with the methods in use at the present time. The bichromated gelatine becomes insoluble in the exposed parts; therefore, for the production of half tones, collotypes and carbon prints, one must print under a negative. This is also necessary in Warnerke's half-tone process, which is founded on the fact that the oxidation product of pyrogallol will only adhere to those places containing silver, and thus tans them. In my experiments other methods of obtaining a relief on gelatine pictures were discovered. Hitherto all such processes have resulted in the unexposed parts dissolving and the exposed remaining. If, for instance, a gelatino-bromide print be treated with a concentrated solution of ammonium bichromate, the unexposed parts swell up and will dissolve in warm water, while those parts containing silver will remain. I will not enter further into the subject, as it appears to possess no advantage over Warnerke's process.

Analogous to the process with the persulphates is that with gelatine containing ferric chloride; ferric chloride tans gelatine very strongly. During exposure the ferric is converted into ferrous chloride, which makes the gelatine soluble. In order to prepare a relief suitable for half tone etching, it is necessary to print under a positive, or exposure may be made in the camera on the film, which is afterward to be used as the etching resist.

I coated a copper plate with gelatino-bromide emulsion, of about the same rapidity as the ordinary process plate. It was remarkable how well the emulsion adhered to the copper; plates which are several weeks old are still good. Such a plate was exposed in the camera behind a ruled screen, and when developed with a normal hydroquinone developer, a vigorous image was formed, which showed not the slightest trace of fog. Fixation was done in the usual way, but now troubles arose with the copper, for it reduced the silver salt dissolved by the hypo, and became covered with a thin film of metallic silver, not only on the back, but between the plate and film, and partly within the same; so that the picture not only showed a strong red fog, but the film was also quite useless for the relief, for every part containing silver behaved exactly as though exposed. I tried to obviate this defect by treating the plate with persulphate of ammonia before fixing, but the relief was not then formed. Some copper plates were now plated with a thin film of silver, and then coated with the emulsion, and this trouble in fixing obviated; but the etching could not be done after silvering, as ammonium persulphate is a solvent for silver, and the etching would, therefore, take place through the material which produces the gelatine relief. It appeared to me to be not impossible to carry the etching right through with the persulphate, as this dissolves metallic copper. But this experiment failed, for the action of the persulphate on the silver of the surface caused the lower portion of the gelatine which was in contact with the same to dissolve, and the image would not adhere firmly.

Silvering of the copper plate, therefore, did not solve the problem. The relief prepared on some other surface could, however, be transferred to the copper plate, but I consider the direct printing of the plate to be etched of considerable value for practical work, and, therefore, my experiments in this direction will be continued. Perhaps a preliminary coating of the plate with a thin film of resin, which, prior to etching, might be dissolved by ether on the places laid bare, would be some assistance.

Of the other applications of the above described reaction which are possible, such as collotype, glass etching and the preparation of pigment positives in camera, etc., I will not speak, as my experiments are not yet finished.—Photo. Archiv.

* It would appear, therefore, that these salts cannot be used for the destruction of the hypo in prints without danger. There is also the fact that the persulphate salts decompose sodium hyposulphite with the separation of sulphur.

ELECTRICAL INDUSTRY IN FRANCE DURING 1897.

By Prof. J. BLONDIN, in The Electrical World.

IN the year which has just come to an end, no invention or new application of very great importance has appeared in any of the various departments of the domain of electricity. Nevertheless, it appears that electricians would scarcely be wise to complain of the results accomplished during the twelve months past, for real advance has been made in all branches of electricity, and particularly in those of traction and electro-chemistry.

Electric traction is the one field which has captured the attention of electricians and of the French public. Introduced some years ago by the powerful company organized in France by the General Electric Company—the French Thomson-Houston Company—traction by the overhead trolley was not slow in gaining public favor, and, by the beginning of 1897, several towns in the provinces possessed installations of electric tramways, of which the total development permitted France to be classed in the second rank of European nations in statistical tables, relative to electric traction. This year, thanks to the activity of the Thomson-Houston Company, and to the creation of a powerful financial association, the Compagnie Générale de Traction, and to the efforts of several other concerns, notably the Compagnie de Fives-Lille, progress has been more rapid. Cities already provided with installations of electric tramways have seen these develop and grow, and a large number of others have commenced the inauguration of this new method of traction. Others yet more numerous are about to begin such installations. The results are most encouraging, and without being a prophet, I can predict that before long electric traction by overhead trolley will have replaced horse traction where that still exists, and will also find its place in many provincial cities where animal traction has not yet been able to establish itself on account of the high cost of its operation.

But if the provincial cities have already profited by the incontestable advantages of electric traction, it is far from being thus the case in Paris, in spite of the public clamor.

There two causes of a different kind stop the efforts of the electricians. In the first place, the concessions accorded to the powerful Compagnie Générale des Omnibus have left for the companies which are attempting to make electrical installations only a choice between a small number of minor and insignificant routes, and, consequently, but little business and no opportunities for profit. In the second place, the overhead trolley has neither the favor of the public nor that of the municipal administration.

The first difficulty is of the kind which can only be overcome by time, that is by waiting for the expiration of the concession accorded to the omnibus company. Unfortunately, this concession will not expire for about fifteen years.

As to the second, the repugnance of the public and the administration for the overhead trolley is without doubt exaggerated, for, while it is true that the overhead conductors would have a deplorable æsthetic effect in the fine quarters, concerning which Paris so justly prides herself, there are many streets where it would be perfectly acceptable.

However, these two difficulties exist, and the first aim of the electricians is to surmount them. With this end in view, efforts have been numerous. The Thomson-Houston Company, for the purpose of allowing the Parisians to understand and easily appreciate the advantages of electric traction, has for the last two years maintained an overhead installation some kilometers distant from Paris, between Le Raincy and Montfermeil. On its part the General Traction Company submitted at the beginning of the year a project for an important installation to serve all Paris and the outlying districts by means of accumulator cars in the interior of the city and the overhead trolley on the exterior. MM. Claret and Vuilleumier installed last year their closed conduit surface contact electric tramway in one of the finest avenues of the city. During the same year the Heilmann Company inaugurated, on several lines, electric traction by rapid charge accumulators, thus following the way opened some years ago by the Société pour le Travail Electrique des Métaux. Finally, unable to do any better, several companies proposed to the omnibus company to install electric traction upon its system. It is thus possible to say that if the Parisians are yet served by a mode of traction which is slow and most uncomfortable, it is certainly not the fault of the electricians.

Elsewhere these numerous efforts have not remained without result. If the recent determination of the General Council of the Department of the Seine is entirely realized, fourteen lines of electric traction will shortly be constructed in the suburbs of Paris, and as the concessionaires of these lines are able to control lines penetrating into Paris, on account of the fact that they are found to be the principal feeders for the Northern Tramway Company, the Southern Tramway Company and the Claret-Vuilleumier Company, the Parisians will soon have an important system of electric tramways penetrating into the heart of the city. Certainly the solution of the problem will not be perfect, on account of the impossibility of connecting the various lines across Paris, but a great step will have been effected. As to the system adopted it is extremely probable and almost certain that it will be the mixed system already used by some continental cities, particularly Hanover—the overhead trolley outside the city and accumulators inside.

To further understand the diverse conditions, and on account of its importance from the point of view of the development of electric traction in France, something must be said here about the Métropolitain. This year the Municipal Council of Paris pronounced itself strongly in favor of the construction of a metropolitan railway straight across Paris, operated by electric traction. The employment of electricity for the working of this railway is to-day accepted by everybody as a necessary consequence of the foreseen volume of traffic, and no one has so far raised any objections. Unfortunately, it is not the same with the construction of the straight right of way, which has encountered many adversaries, among which are numbered the government and the large railway companies. This solution does not permit of the union of the metropolitan line with the larger railways, particularly with the belt line road which should be considered as a sort of feeder for the future metropolitan line. Under all these conditions it looks as if it would be imprudent to pronounce upon the date when Paris will possess her metropolitan line. To conclude the subject of electric traction as applied to urban transportation, the electric railway which is about to be constructed to serve the various parts of the exposition of 1900 should be mentioned.

The application of electricity to traction on heavy railways has been the object of important experiments undertaken by the Société des Etablissements Heilmann. The locomotive, of which a description was published in The Electrical World during the past year, has been on trial now for two months on the tracks of the Compagnie des Chemins de Fer de l'Ouest, and the satisfactory results obtained lead to the hope that in a little while, or as soon as the second locomotive now under construction is ready, a regular electric service will be inaugurated. The same company has undertaken at this time a series of tests of a different kind on a line about a mile long, also belonging to the Western Railway system at St. Germain. There traction is effected by the ordinary electric locomotive to which current is fed by an insulated rail, this being the system ordinarily known as the third rail. These experiments are made with a view to the application of electric traction on the belt line, the suburban and the metropolitan lines.

Electro-chemistry is, as was remarked at the beginning, that application of electricity which has made during the year the greatest progress, with the exception of traction. But in this branch of industry nearly everything is kept secret, and while it is easy to see that a new factory has been installed, it is almost impossible to learn what is done inside of it. It must not be forgotten that during the year new factories, all of them operated by turbine water wheels, have been erected for the manufacture of calcium carbide, of electrolytic sodium by the Hulin process, of bleaching hypochlorites, chlorates, and even of ozone. I regret that I am not able longer to tarry upon this interesting application of electricity, because it has a considerable importance in the development of the riches of France, and permits the utilization of motive power of numerous waterfalls, up to this time unemployed. A singular demonstration of this is the high prices which are to-day asked for any kind of waterfall—things which have had no value until a few years ago.

Passing now to other applications of electrical energy, there is much progress to record, though less important than the preceding matters. Long distance transmission of power has benefited considerably by the extension of the utilization of waterfalls for the electro-chemical industries, and in the east of France, in the Alpine region, numerous installations have been put in or are projected.

Work on the Jonage Canal, which will permit the utilization by numerous workshops in the regions of Lyons of about 10,000 horse power withdrawn from the Rhone, is advancing rapidly, and it is probable that the year 1898 will not pass without seeing the completion of these works. Many electricians now believe in the commercial possibility of transmitting the energy of waterfalls to distances of 100 kilometers, and hope to find in agricultural operations considerable opportunity for the utilization of this energy. Some experiments made recently in the application of electrical power to agriculture appear to augur well for this new departure.

The electrical transmission of power in factories and shops counts to-day numberless partisans. Many new factories have adopted this mode of transmission, and the older concerns are coming little by little to the point where the need of changing their methods begins to make itself felt. The advantages of electrical transmission are now no longer a subject for discussion, and it is easy to predict that this branch of electrical industry will soon take a considerable forward movement.

Electric lighting is progressing without great speed. This is largely on account of the fact that in many of the towns the municipalities are under contract with the gas companies to preserve their monopoly in lighting. This has resulted also in the selling price of electrical energy being much too high. Meanwhile in some places the gas companies appear to have decided to install for themselves electric stations, where, on account of other concessions, they are in competition with the gas installation belonging to another company. This new attitude of the gas companies allows the hope that electric lighting will soon meet with a considerable extension.

The extension of the application of electricity has necessarily had for its consequence the growth of the manufacture of apparatus for its generation and utilization. The construction of the direct current dynamo has been the opportunity for much labor for the perfection of detail, and, above all, for the reduction of dimensions for a given power. The construction of alternators permits to inventors the realization of the most marked perfection. During the year the Farcot concern delivered to the central station at the Champs Elysées some alternators built on the Leblanc and Hutin systems, which have shown considerable economy. The transformation of direct current into alternating and the inverse transformation have been the object of much study. Several Alioth rotaries are now in operation in generating stations, and the fears which were expressed at the beginning of their employment do not appear to be justified, those who are using them having spoken with satisfaction of their operation. Meanwhile M. Leblanc is making practical his system of transformation by means of rectifiers, and trials recently made on those installed on the electric system of the Compagnie des Chemins de Fer du Nord have left no doubt about the practical value of this system. The accumulators, which are becoming more and more generally used in generating stations and for traction, and which seem to continue to be employed, at least in Paris, for accumulator traction, have naturally been

the object of many detailed studies, but there is no extraordinary progress to recount. The announcement has just been made of the appearance of a new accumulator made of zinc, and having, over the present types, the advantage of relatively small weight for given capacity, and, consequently, great convenience for accumulator traction.

If we look upon the progress accomplished this year in France in electrical industries, we should feel satisfied with the results accomplished in the diverse branches of its application, and particularly with those achieved in traction and electro-chemistry. So, looking at the future, I can predict that a rapid extension of these two applications will take place, and at no far future time there will be considerable development in the utilization of waterfalls. The electric industries in France, without being in as satisfactory a condition as one could wish, are yet at this time unquestionably on the road to marked progress.

LIFE AND CANDLE-POWER OF INCANDESCENT LAMPS.

WHILE the theoretically perfect incandescent lamp should maintain its original candle power indefinitely, there is a constant and gradual deterioration of the filament which creates a steady loss of candle-power. The best lamp is that which, with a minimum cost, produces the maximum light. Since the loss is gradual and constant, and in a certain sense cumulative, there is bound to come a time in the life of a lamp when its continued use ceases to be economical. This subject is well explained in a recent publication by the General Electric Company, says The Iron Age, in which the broad statement is made that there is no lamp yet made which it is economical to burn over 1000 hours, and in the great majority of cases the limit is under 600 hours. An incandescent lamp is considered simply as a transformer, receiving current and transforming it into light. The efficiency decreases, and after a time there may be a loss of 50 per cent.; that is, the same current yields only about one-half the light. Such a state of affairs in an engine or boiler would demand prompt repair or replacement. Attempting to remedy this by raising the voltage is bad practice, since the increased pressure damages every new lamp placed in the circuit. These principles are recognized by the large lighting companies, who employ a force of men to weed out all dim lamps. An average life of 600 hours should be assumed, and the records should show how many lamps should be renewed each month to keep the average within this limit.

Excessive voltage is not recommended, because it decreases the total light of the lamps and increases the power required. When light is sold by meter the added power consumption dissatisfies the customers, and when sold by contract there is a dead loss to the station. The commercial life of the lamp is also decreased by increased pressure, and this decrease is at a far more rapid rate than the increase of pressure. It is shown that a 3 per cent. increase of voltage sacrifices one-half of the life of a lamp, while a 6 per cent. increase reduces the life by two-thirds. These assumptions apply with special significance to alternating current systems, in which there are two sources of possible irregularity in voltage—the generator and the transformer. The substitution of one large transformer for a number of small ones, and of those of modern type for the old and inefficient ones, has been of great advantage to stations. In the selection of transformers the essential consideration is quality, which should have preference over first cost. The transformer should maintain its voltage ratio well within 3 per cent. from full load to no load. Constant voltage at the station is not what is wanted so much as constant voltage at the lamps, and this can only be attained by the frequent use of reliable portable voltmeters. The lamps should conform to this voltage.

A lamp has passed its useful life when it has lost 20 per cent. of its candle-power, which, in the case of a 16 candle-power lamp, would be 12·8 candle-power. The useful life of the lamp is the period during which it suffered this loss. The practical method of comparison is as follows.

Lamps of similar candle-power and voltage are burned at the same initial efficiency of 3·1 watts per candle on circuits whose voltage is maintained exactly normal. At periods of 50, 75 or 100 hours the lamps are removed from the circuits and candle-power readings taken, the lamps being replaced in circuit at the end of each reading. Readings are thus continued until the candle-power drops to 80 per cent. of normal. The results obtained are then plotted in curves, and the areas under these curves give the "candle-hours" and the relative value of the different lamps.

The custom of free lamp renewals applies to all stations, and with the present low cost of lamps is advisable for both customer and station.

The blackening of bulbs is another defect in incandescent lamps, and while a lamp may lose in candle-power and exhibit but little blackening, it may, on the other hand, get quite black and lose little in candle-power. This is illustrated by the fact that a 50-volt lamp, which has a more stable filament than the 110-volt lamp, often shows considerable blackening with little loss of candle-power. The remedy for blackened lamps is correct regulation of pressure and frequent renewals.

Concerning illumination, it is stated that two 16 candle-power lamps per 100 square feet of floor space give good illumination, three very bright, and four brilliant light. These figures are modified by height of ceiling, color of walls and ceiling, and other conditions. White walls only require about one-third as many lights as dark ones for the same illumination. Large lamps may be used for lighting large areas, but a given area will be more effectively lighted by an equivalent number of 16 candle-power lamps. While the foregoing applies more directly to station systems, it contains hints of value to all those establishments provided with their own electric lighting plants. Those considerations affecting the economical and efficient operation of the one obtain in the case of the other.

Recent Books.

Slide Valves. A Book for Ppractical Men on the Principles and Methods of Design, with an Explanation of the Principles of Shaft Governors. By C. W. MacCord, Jr., M.E. 8vo, cloth. 168 pages and 101 illustrations. 1897.....$2 00

Sugar. A Handbook for Chemists of Beet Sugar Houses and Seed Culture Farms. Containing Selected Methods of Analysis, Sugar House Control, Reference Tables, etc. By G. L. Spencer. 12mo, morocco. New York, 1897.....$3 00

Sugar. A New and Profitable Industry in the United States. For Capital, Agriculture and Labor to Supply the Home Market yearly with $100,000,000 of its Product. The Sugar Industry of America. Its Past, Present and Future. How to enable our own people to produce all they consume, and thus put into their own pockets the vast sums now sent abroad annually to pay for imported sugar. A practical aid toward relieving agricultural depression by affording hundreds of extensive home markets for thousands of acres of Sugar Beets and Cane. The whole sugar situation comprehensively discussed, with illustrated descriptions of all cultural and factory processes, an Index to the American Sugar Trade, and a directory of many localities that offer exceptional inducements to capital to embark in Beet Sugar and Cane Sugar. By Herbert Myrick. 148 pages. Cloth. New York, 1897.....$0 50

Sunlight and Shadow. A Book for Photographers, Amateur and Professional. Edited by W. I. Lincoln Adams. Illustrated by original photographs from nature. 8vo, handsomely bound in cloth, full gilt edges. 141 pages. New York, 1897.....$2 50

Textiles. The Printing of Textile Fabrics. A Practical Manual on the Printing of Cotton, Woolen, Silk, and Half Silk Fabrics. By C. F. Seymour Rothwell. With plates and illustrations in the text and specimens of printed fabrics. 8vo, cloth. London and Philadelphia, 1897.....$6 50

Tobacco Leaf. Its Culture and Cure, Marketing and Manufacture. A Practical Handbook on the most approved methods in growing, harvesting, curing, packing and selling tobacco; also of tobacco manufacture. By J. B. Killebrew and Herbert Myrick, assisted by successful tobacco growers, dealers in the leaf, manufacturers of tobacco and by specialists in the sciences. Profusely illustrated. 12mo, cloth. 500 pages. New York, 1897.....$2 00

Valves and Valve Gearing. A Practical Text Book for the Use of Engineers, Draughtsmen and Students. By Charles Hurst. With numerous illustrations and 4 folding plates. 8vo, cloth. 125 pages. London, 1897.....$3 00

Volcanoes of North America. A Reading Lesson for Students of Geography and Geology. By Israel C. Russell. 8vo, cloth. 346 pages. Fully illustrated. London and New York, 1897..$4 00

Wrestling. A Handbook of Wrestling. By Hugh F. Leonard, Instructor in Wrestling at the New York Athletic Club. 12mo, cloth. New York, 1897.....$2 50

Wood Carving. Practical Wood Carving. A Simple Treatise on the Rudiments of Wood Carving, embracing the proper method of handling tools, as well as the correct shapes for grinding them in order to produce different kinds of work. By Chas. J. Townsend. Illustrated by hundreds of engravings of original drawings. Full bound cloth. 12mo. New York, 1897.....$1 00

Wood Finishing. Comprising Staining, Varnishing and Polishing; with Engravings and Diagrams. Edited by Paul N. Hasluck. (Work Handbooks.) 16mo, cloth. 128 pages. Illustrated. London, 1897.....$0 50

X Rays. The Induction Coil in Practical Work. Including Roentgen Rays. By Lewis Wright. 12mo, cloth. 72 illustrations. 172 pages. London and New York, 1897.....$1 25

Our large Catalogue of American and Foreign Scientific and Technical Books, embracing more than Fifty different subjects, and containing 116 pages, will be mailed, free, to any address in the world.

Any of the foregoing Books mailed, on receipt of price, to any address. Remit by Draft, Postal Note, Check, or Money Order, to order of

MUNN & CO.,
361 BROADWAY, NEW YORK.

MAGIC

Stage Illusions and Scientific Diversions, Including Trick Photography.

By ALBERT A. HOPKINS,
Editor of the "Scientific American Cyclopedia of Receipts, Notes and Queries," etc.

This unique work appeals to the professional and the amateur alike, and will prove a welcome addition to any library. The illusions are illustrated by the highest class of engravings.

Great attention is paid to the exposés of large and important illusions; these have been in many cases furnished by the prestidigitateurs themselves. Some of the most important tricks of Robert Houdin, Bautier de Kolta, Heller, and Herrmann are explained. Conjuring is not neglected, a selection of some of the best known of these tricks having been made. Fire-eaters, sword-swallowers, ventriloquists, shadowgraphists, all come in for a share of attention, while the chapter on "Mental Magic" describes simple means of performing second-sight.

Such entertainments as cycloramas, fireworks, etc., are also treated, and all well illustrated with original engravings. Automata and curious toys are then described.

This work is acknowledged by the **Profession** to be

THE STANDARD WORK ON MAGIC.

The section devoted to Photographic Diversions is very complete, giving the method of producing astonishing trick photographs. The method of taking and projecting moving photographs is described in detail—the vitascope, the cinematograph, the mutoscope, and the mutograph being fully described and illustrated. This work cannot fail to be of interest to young and old, and there is hardly any one who is in any way interested in either science or magic to whom it will not appeal. It is beautifully printed and is very attractively bound in special cloth, with stamp in colored inks.

SECOND EDITION NOW READY.

368 Pages. 420 Illustrations.
Price, by mail to any part of the world, $2.50.
An Illustrated Circular sent on Application.

MUNN & CO., 361 Broadway, New York.

A COMPLETE

ELECTRICAL LIBRARY

BY PROF. T. O'CONOR SLOANE,

Comprising five books, as follows:

Arithmetic of Electricity, 138 pages	**$1.00**
Electric Toy Making, 140 pages	**1.00**
How to Become a Successful Electrician, 189 pp.	**1.00**
Standard Electrical Dictionary, 682 pages	**3.00**
Electricity Simplified, 158 pages	**1.00**

☞ The above five books by Prof. Sloane may be purchased singly at the published prices, or the set complete, put up in a neat folding box, will be furnished to Scientific American readers at the special reduced price of **Five dollars.** You save $2 by ordering the complete set. **Five volumes, 1,300 pages, and over 450 illustrations.**

☞ Send for full table of contents of each of the books.

☞ Our complete book catalogue of 116 pages, containing reference to works of a scientific and technical character, will be sent free to any address on application.

MUNN & CO., Publishers, 361 Broadway, N. Y.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents, and canvassers.

MUNN & CO., Publishers,
361 Broadway, New York, N. Y.

TABLE OF CONTENTS.

PAGE

I. ASTRONOMY.—The Progress of Astronomy in 1897.—An interesting review of the progress of astronomy during the past year..... 18455

II. BOTANY AND HORTICULTURE.—Trees and Change of Temperature..... 18456
Renanthera Imschootiana.—1 illustration..... 18456

III. CHEMISTRY.—On the Absorption of Hydrogen by Palladium at High Temperatures and Pressures.—By Prof. JAMES DEWAR.—This article details important experiments which have been tried by the celebrated English chemist.—1 illustration..... 18458
Appropriation of Free Atmospheric Nitrogen..... 18459

IV. COMMERCE.—Obstacles to Commerce.—A valuable article by CYRUS C. ADAMS, the geographer..... 18464

V. COSMETICS.—Suggestions Concerning the Manufacture of Cold Cream..... 18456

VI. ELECTRICITY.—Electrical Industry in France during 1897.—By Prof. J. BLONDIN..... 18467
Life and Candle Power of Incandescent Lamps..... 18468

VII. FISHERIES.—Our Fur Seals.—An interesting account of the seal fisheries in the Bering Sea, detailing the cause of the trouble with England concerning them and the legislation which has been adopted.—5 illustrations..... 18453

VIII. MARINE ENGINEERING.—Baron Nathaniel v. Rothschild's Steam Yacht "Vegila."—1 illustration..... 18465

IX. MEDICINE AND HYGIENE.—A Case of Jealousy.—By WILLIAM O'NEILL, M.D..... 18457
Cure of the Deaf and of Deaf Mutes.—An interesting account of the microphonograph, designed for awakening and educating the sense of hearing in the deaf.—3 illustrations..... 18457

X. MISCELLANEOUS:
Engineering Notes..... 18462
Miscellaneous Notes..... 18462
Selected Formulæ..... 18462

XI. PHOTOGRAPHY.—A New Basis for Photo-Mechanical Processes.—By R. ED. LIESEGANG..... 18460
Hints on the Brush Development of Platinum Prints.—By T. PERKINS..... 18463
Bromide Printing.—By R. T. COLLINS..... 18463

XII. SCIENCE.—Visits to Scientific Institutions in Europe.—A paper by EDWARD W. MORLEY, Ph.D., LL.D., describing visits to some of the most important institutions in Europe connected with weights and measures..... 18459

XIII. STEAM ENGINEERING.—The Yarrow-Schlick-Tweedy System of Balancing Engines.—1 illustration..... 18464

XIV. TECHNOLOGY.—The Size and Water Marks on Paper..... 18466
Paints and Their Vagaries..... 18466

XV. TRAVEL AND EXPLORATION.—Hayti.—This article details some of the interesting particulars concerning the history of the island of Hayti, with views which give an idea of the country..... 18461

SPECIAL ANNIVERSARY NUMBER

of the SCIENTIFIC AMERICAN, containing eighty illustrations and a resumé of fifty years of progress in fifteen branches of science. 72 pages. Single copies, 25 cents, sent by mail in United States, Canada, and Mexico. Foreign countries 8 cents extra.

MUNN & CO., 361 Broadway, New York.

1897 Supplement Catalogue Ready!

The publishers of the SCIENTIFIC AMERICAN announce that an entirely new 48 page SUPPLEMENT Catalogue is now ready for distribution, and will be sent free to all on application.

MUNN & CO., Publishers,
361 Broadway, New York City.

BUILDING EDITION

OF THE

SCIENTIFIC AMERICAN.

Those who contemplate building should not fail to subscribe.

ONLY $2.50 A YEAR.

Semi-annual bound volumes $2.00 each, yearly bound volumes $3.50 each, prepaid by mail.

Each number contains elevations and plans of a variety of country houses; also a handsome

COLORED PLATE.

MUNN & CO., 361 Broadway, New York.

PATENTS!

MESSRS. MUNN & CO., in connection with the publication of the SCIENTIFIC AMERICAN, continue to examine improvements, and to act as Solicitors of Patents for Inventors.

In this line of business they have had *fifty years' experience*, and now have *unequaled facilities* for the preparation of Patent Drawings, Specifications, and the prosecution of Applications for Patents in the United States, Canada, and Foreign Countries. Messrs. Munn & Co. also attend to the preparation of Caveats, Copyrights for Books, Trade Marks, Reissues, Assignments, and Reports on Infringements of Patents. All business intrusted to them is done with special care and promptness, on very reasonable terms.

A pamphlet sent free of charge, on application, containing full information about Patents and how to procure them; directions concerning Trade Marks, Copyrights, Designs, Patents, Appeals, Reissues, Infringements, Assignments, Rejected Cases, Hints on the Sale of Patents, etc.

We also send, *free of charge*, a Synopsis of Foreign Patent Laws showing the cost and method of securing patents in all the principal countries of the world.

MUNN & CO., Solicitors of Patents,
361 Broadway, New York.
BRANCH OFFICES.—No. 625 F Street, Washington, D. C.

, 1898.

ement.

ear.

bers in any
ix dollars a

T, from the
ad. Price,

NT can like-
ied yearly,
er, or $3.50

FIC AMERI-
N SUPPLE-

agents, and

rk, N. Y.

PAGE
interest-
year..... 18455
of Tem-
..... 18456
..... 18456
alladium
DEWAR.
ve been
..... 18458
..... 18459
rticle by
..... 18464
e of Cold
..... 18456
ng 1897.—
..... 18467
..... 18468
of the
of the
on which
..... 18453
haschild's
..... 18465
By WIL-
..... 18457
count of
ating the
..... 18457
..... 18462
..... 18462
..... 18462
cal Pro
..... 18466
s.—By T.
..... 18463
..... 18463
A paper
to some
ed with
..... 18459
dy Sys-
..... 18464
..... 18466
..... 18466
icle de-
history
he coun-
..... 18461

BER
and a resumé
ages. Single
Mexico, For-
v York.

ndy!
RICAN an-
PLEMENT
d will be
rk City.

ION
AN.
ot fail to
n, yearly
ans of a
York.

'S!
the publica-
to examine
ents for In-
ce, and new
ngs, Specifi-
the United
so attend to
s, Reissues,
business in-
very reason-
ull informa-
rning Trade
ringements,
e.
ws showing
countries of